BUILT ENVIRONMENT PROFESSIONALS' PERCEPTION OF BUILDING DEFECTS IN BENIN CITY, EDO STATE, NIGERIA

BY

OSAYANDE UKPEBOR

MAT. NO. PG/ENV2215691

BEING A RESEARCH PRESENTED TO THE

DEPARTMENT OF QUANTITY SURVEYING,

FACULTY OF ENVIRONMENTAL SCIENCES,

UNIVERSITY OF BENIN,

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IN PARTIAL FUFILLMENT OF THE REQUIREMENT FOR THE AWARD OF POST GRADUATE DEPLOMA (PGD) IN CONSTUCTION MANAGEMENT

2025

CERTIFICATION

We, the undersigned, hereby certify that this project work was carried out by Mr. Osayande Ukpebor, and we confirm that the study is adequate in both scope and quality, and it satisfies the requirements for the award of a Postgraduate Degree in Construction Management.

________________________ _______________

Prof. Okorie, Victor Nnannaya **Date**

(Project Supervisor)

_________________________ ________________

Dr. Fawale, Tolutope Samuel **Date**

(Ag. Head of Department)

DEDICATION

I dedicate this project to God Almighty for His divine guidance, protection, and unending mercy towards me and my family throughout this journey.

ACKNOWLEDGEMENT

I sincerely appreciate my project supervisor, Prof. Victor Nnannaya Okorie, for his invaluable guidance, encouragement, and constructive criticisms that shaped the outcome of this work. My profound gratitude also goes to the Head of Department, Dr. Fawale Tolulope Samuel, for his support and leadership throughout this academic journey.

I am equally grateful to Prof. Chukwuemeka Ogbu Patrick for his remarkable contributions to my academic growth and knowledge development.

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ABSTRACT

Building defects have become a critical issue in the Nigerian construction industry, contributing to structural failures, safety risks, economic losses, and increased incidence of building collapses. This study investigates the perceptions of built environment professionals regarding the causes, frequency, and prevention strategies for building defects in Benin City, Edo State, Nigeria. A quantitative research approach was adopted involving administering structured questionnaire to 114 professionals comprising Engineers, Architects, Builders, Quantity Surveyors, and Estate Surveyors. Data were analyzed using Mean Item Score and the Mann-Whitney U test. Findings revealed that cracks in walls/foundations, poor drainage, and roof leaks are the most prevalent defects across both public and private buildings in Benin City. The findings show no significant difference in the occurrence of defects between public and private sectors, highlighting industry-wide challenges such as poor workmanship, inadequate maintenance, and the use of substandard materials. A critical finding of the study is the lack of regular maintenance culture and insufficient professional oversight, which significantly contributed to the defects of building and facilities. The study recommends stricter enforcement of building codes, improved quality control, regular maintenance, and enhanced professional training to mitigate building defects. The study further recommends that policymakers, practitioners, and stakeholders should aimed at improving building performance, safety, and durability within the rapidly growing urban environment of Benin City. Furthermore, the research highlights the need for a more integrated and collaborative approach among stakeholders, including government regulatory bodies, construction professionals, and property developers. The study also emphasized that while both public and private buildings face similar defect challenges, systemic issues such as corruption, budgetary constraints, and poor policy implementation exacerbate the situation in the public sector. This study contributes to the existing body of knowledge by presenting a contextual analysis of building defects specific to Benin City, offering both empirical data and practical recommendations. The adoption of digital tools such as Building Information Modelling (BIM), improved regulatory compliance, and investment in capacity building for construction professionals are proposed as sustainable strategies. Ultimately, this research underscores the importance of proactive maintenance planning, quality assurance, and stakeholder education in fostering a safer, more resilient built environment in Nigeria.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The building industry plays an indispensable role in human existence and societal development. Buildings are not merely shelters but functional environments that enable social, cultural, and economic activities. They serve as spaces for living, learning, working, recreation, and healthcare. In every society, the construction sector contributes significantly to gross domestic product (GDP), employment generation, and infrastructural development (Olanrewaju & Abdulaziz, 2015). However, the utility and sustainability of buildings are frequently compromised by the presence of defects.

Building defects are imperfections or deficiencies in design, materials, workmanship, or maintenance that adversely affect the performance, functionality, and safety of a structure. Globally, building defects are recognized as one of the most critical challenges of the construction industry (Ismail *et al*., 2015). Studies across the United States, United Kingdom, Malaysia, and Singapore show that even in technologically advanced environments, defects such as cracks, leaks, dampness, corrosion, poor finishes, and mechanical failures are common occurrences. The persistence of defects undermines the durability of infrastructure and reduces user satisfaction.

In developing countries, particularly Nigeria, the magnitude of the problem is compounded by weak institutional structures, limited technical capacity, and rapid urbanization pressures. Nigeria's construction industry faces systemic challenges including poor workmanship, the use of substandard materials, inadequate supervision, corruption, and weak enforcement of building codes. The effects of these shortcomings manifest in a wide range of defects such as cracks in foundations and walls, peeling paint, roof leaks, spalling concrete, plumbing failures, and even catastrophic building collapses. The Nigerian Institute of Building (NIOB, 2020) reported that over 200 cases of building collapse occurred between 1974 and 2020, many traceable to cumulative defects that were either neglected or poorly addressed.

In Benin City, Edo State, the story is not different. As a rapidly urbanizing city with a mix of modern and traditional building practices, defects are widely observed across residential, commercial, and institutional structures. Common problems include roof leakages during heavy rains, wall cracks caused by foundation settlement, poor drainage resulting in waterlogging, and premature deterioration of finishes. The weak enforcement of urban planning laws, reliance on unskilled labor, and non-compliance with standards exacerbate the challenge. For instance, Enoma and Idehen (2018) noted that many public schools and health facilities in Edo State exhibit persistent defects that reduce functionality and pose risks to users.

The implications of building defects are severe. They increase maintenance and repair costs, reduce property value, and in extreme cases, lead to building collapse, loss of investment, and fatalities. Moreover, they compromise the sustainability of the built environment, as defective buildings consume more resources for repair and reconstruction. This situation underscores the urgent need to investigate and address building defects in Benin City through the lens of built environment professionals who are directly responsible for design, supervision, and construction.

1.2 Statement of the Problem

Despite significant investments in Nigeria’s construction industry, defects continue to undermine the sector’s performance. In Benin City, both public and private buildings display recurring defects such as wall cracks, roof leaks, peeling finishes, drainage problems, and structural failures. These defects are not isolated but systemic, reflecting deep-rooted issues such as:

- Poor workmanship due to reliance on unskilled or untrained artisans.
- Use of substandard materials like adulterated cement, low-quality reinforcement steel, and inferior finishes.
- Design errors and poor planning, especially in drainage and structural detailing.
- Inadequate supervision during construction, with contractors often left unchecked.
- Weak maintenance culture, where repairs are delayed until problems worsen.
- Regulatory lapses, as building codes and standards are poorly enforced.

The persistence of these problems poses serious risks. Families live in unsafe conditions, government spends excessively on repairs of public infrastructure, and investors lose confidence in property markets. According to Awasho and Alemu (2023), the frequency of defects in Nigerian buildings continues to rise, with associated risks of collapse and economic loss. Without urgent intervention, the trend in Benin City will continue, threatening safety, quality of life, and the sustainability of the built environment.

1.3 Research Questions

This study is guided by the following questions:

1. What is the frequency of building defects in Benin City?

2. How do defects differ between public and private buildings in Benin City?

3. What are the major causes of building defects in Benin City?

4. What strategies can minimize and prevent defects in Benin City?

1.4 Aim and Objectives

Aim:

The main aim of this study is to examine built environment professionals' perceptions of building defects in Benin City with a view to minimizing their effects.

Objectives:

1. To identify the frequency of building defects in Benin City.

2. To compare defects in public and private buildings in Benin City.

3. To analyze the causes of defects in Benin City.

4. To recommend strategies for prevention in Benin City.

1.5 Scope of the Study

This study is restricted to Benin City, Edo State, focusing on five categories of construction professionals: architects, engineers, builders, quantity surveyors, and estate surveyors. It examines their perceptions of building defects in both public and private buildings, including residential, commercial, and institutional structures.

1.6 Significance of the Study

This study is significant in several respects:

Policy Makers: It provides evidence-based insights that will support the formulation and enforcement of building regulations, ensuring safer and more sustainable structures.

Practitioners: It offers professionals an understanding of recurring defects, enabling improved design, supervision, and quality control measures.

Academics: It contributes to the body of knowledge on building performance and defects in Nigeria, serving as a reference for future research.

End Users: Indirectly, the findings will enhance safety, comfort, and durability of buildings for residents, thereby improving quality of life.

CHAPTER TWO

LITERATURE REVIEW

2.1 Concept of Building Defects

The term building defect refers to any shortcoming, imperfection, or deficiency in a building that prevents it from performing its intended functions. These functions include safety, durability, aesthetics, and user comfort. According to Isa *et al*. (2016), a defect is a failure in design, workmanship, or materials that negatively affects the value and usability of a structure. Building defects may be minor, such as paint peeling, or major, such as foundation settlement leading to collapse.

In developed countries, defect studies emphasize post-occupancy evaluation, whereby users' experiences highlight functional and comfort-related issues (Wood & Swan, 2015). In developing countries like Nigeria, defects are often more fundamental, arising from poor construction practices, weak regulation, and environmental stressors (Enoma & Idehen, 2018).

Defects are inevitable to some degree; however, their frequency and severity can be minimized through strict adherence to standards, skilled supervision, and effective maintenance (Yoon *et al*., 2021).

2.2 Categories of Defects

Defects are commonly divided into structural and non-structural categories:

1. **Structural Defects:** These affect the stability and safety of a building. Examples include foundation failure, wall cracks due to differential settlement, corrosion of reinforcement, roof

sagging, and load-bearing wall collapse. Structural defects are often the most dangerous because they compromise the integrity of the entire building.

2. **Non-Structural Defects:** These do not directly affect structural stability but impair aesthetics, usability, and comfort. Examples include dampness, leaking roofs, poor finishes, peeling paint, and plumbing failures.

Talib and Sulieman (2020) argue that both categories are interrelated: neglected non-structural defects such as dampness can eventually lead to structural problems like concrete spalling.

Table 2.1: Comparison of structural vs. non-structural defects with examples and consequences.

	Structural defects	Non-structural defects
Definition	Flaws that occur in the load-bearing elements of a building (foundation, beams, columns, slabs, load-bearing walls). They threaten the stability and safety of the structure.	Flaws that occur in parts of a building not responsible for carrying major loads (plastering, finishes, doors, windows, roofing sheets, piping, painting). They mainly affect durability, appearance, and comfort, not immediate safety.
Examples	Structural defects	Non-structural defects
	• Foundation settlement or differential settlement • Major cracks in beams, columns, or slabs • Corrosion of reinforcement leading to spalling concrete • Buckling of columns or bending of beams • Roof truss failure	• Cracks in plaster or wall finishes • Peeling paint, efflorescence, damp patches • Roof leakages and ceiling stains • Defective tiling, flooring, or skirting • Faulty doors, windows, and plumbing installations
Consequences	Structural defects	Non-structural defects
	• Risk of partial or total collapse of the building • Loss of lives and injuries to occupants • Very high repair or reconstruction costs • Legal liabilities for owners/contractors	• Reduced building aesthetics and property value • Increased maintenance cost (frequent repairs, repainting, waterproofing) • Occupant discomfort (leakages, mold, termite attacks, poor finishes)

	• Displacement of occupants and interruption of use	• Potential escalation into structural problems (e.g., untreated dampness causing reinforcement corrosion)

2.3 Types of Defects

A more detailed classification of defects reveals the following types:

2.3.1 Water-Related Defects

These are among the most common in Nigeria due to heavy rainfall and poor drainage. They include roof leakages, rising dampness, flooding, water ponding around foundations, and mold growth. Alfano *et al*. (2023) observed that moisture penetration is a leading cause of both aesthetic and structural deterioration. In Benin City, clogged drains and improper slope gradients often exacerbate water-related defects.

2.3.2 Finishing Defects

These include uneven plastering, cracks in coatings, peeling paint, and poor tiling. Yoon *et al*. (2021) note that finishing defects are often a result of poor workmanship and haste to meet deadlines. Although they are sometimes dismissed as cosmetic, they significantly reduce the life cycle of a building.

2.3.3 Electrical Defects

Electrical faults such as poor wiring, overloaded circuits, and malfunctioning equipment can cause both inconvenience and fire hazards. Grondzik and Kwok (2019) stress that improper design and unqualified electricians are major contributors. In Nigeria, the widespread use of informal artisans without certification worsens the problem.

2.3.4 Mechanical Defects

Mechanical systems such as plumbing, heating, ventilation, and air-conditioning (HVAC) often fail due to poor installation and lack of maintenance. Plumbing leaks are common in residential apartments in Benin City, often leading to dampness and mold. Poor drainage planning further contributes to this category.

2.3.5 Environmental Defects

These result from external conditions such as termites, high humidity, corrosion, and temperature fluctuations. Talib and Sulieman (2020) reported that timber warping and termite attack are rampant in tropical climates. In Edo State, termite infestation is particularly problematic in low-cost housing units.

2.4 Causes of Defects

Scholars have identified multiple causes of defects, many of which are interrelated.

Poor Workmanship: Hasan *et al*. (2016) describe workmanship as the single most critical factor. The use of unskilled labor, inadequate training, and lack of supervision often result in poor-quality work.

Substandard Materials: Faremi *et al*. (2020) note that inferior cement, steel, and finishes are widely used in Nigeria due to cost-cutting and corruption. Such materials quickly deteriorate under environmental stress.

Design and Planning Errors: Mistakes in structural calculations, poor layouts, and lack of consideration for site conditions often lead to long-term failures (Salim *et al*., 2016).

Weak Supervision: Isa *et al*. (2016) emphasize that limited oversight during construction allows contractors to substitute materials and neglect standards.

Lack of Maintenance: Yamov & Belyaeva (2019) state that routine inspections are often ignored, allowing small defects to escalate into major problems.

Environmental Influences: Faqih *et al*. (2020) highlight the role of humidity, rainfall, and temperature in accelerating deterioration.

Weak Regulatory Enforcement: Fakunle *et al*. (2020) argue that corruption and inadequate monitoring by regulatory bodies perpetuate defects in Nigeria's construction sector.

2.5 Public vs. Private Sector Defects

Defects occur in both public and private buildings, though the underlying causes may differ:

Public Sector: Corruption, cost-cutting, delayed funding, and weak accountability mechanisms result in large-scale defects. Examples include leaking roofs in public schools and cracks in newly built government offices.

Private Sector: Defects are often linked to poor planning, material substitution, and unqualified contractors hired to reduce costs. Many residential estates in Benin City suffer from poor drainage and finishing defects.

Comparative studies (Enoma & Idehen, 2018) show that while public buildings face systemic corruption, private buildings are more affected by owner negligence and material substitution.

2.6 Strategies for Prevention

Numerous strategies have been proposed to minimize building defects:

1. **Strict Enforcement of Building Codes:** Regulatory agencies must ensure compliance through site inspections and penalties for violations.

2. **Quality Assurance in Materials:** Use of certified suppliers and laboratory testing of materials should be mandatory.

3. **Skilled Manpower and Supervision:** Training of artisans, builders, and supervisors will reduce errors.

4. **Planned Maintenance:** Preventive maintenance schedules must be institutionalized.

5. **Digital Tools:** Adoption of Building Information Modelling (BIM), drones, and monitoring technologies enables early detection of defects (Yoon *et al*., 2021).

6. **Professional Collaboration:** Architects, engineers, builders, and regulators should work collectively to enforce standards.

Table 2.2 Types Building defects

S/N	BUILDING DEFECTS	SOURCE
1	Cracks in walls	Awol *et al.* (2016)
2	Dampness /moisture	Talib and Sulieman (2020)
3	Corrosion/Rusting	Jamaluddin *et al.* (2018)
4	Mould and Fungi	Omar Bakri & Othuman Mydin (2014), Awol *et al.* (2016)
5	Leaking downpipes, leaky roofs	Awol *et al.* (2016), (Kian, 2001)
6	Spalling, commonly known as spallation	Latip *et al.* (2020)
7	Water Ponding	Che-Ani *et al.* (2015)
9	Installation error	Atkinson (2002); Forcada *et al*. (2014)
10	Pest attack	Omar Bakri & Othuman Mydin (2014),
12	Rot and mold	Felipo & Charpin (2022).
13	Clogging	Gurmu & Mudiyanselage (2023).
14	Stretching and tearing	Mohd Hanipa & Hassin (2018).
15	Blistering	Bakri & Mydin (2014)
16	Distortion	Ismail *et al*. 2015
17	Bending/sagging	Azman (2022).
18	Condensation	Ismail *et al*. (2015)
19	Porosity	Wang *et al*. (2022)
20	Inadequate venting	Fowler (2018); Yacob *et al*. (2022)
21	Uneven plastering	Sravani *et al*. (2020).
22	Poor drainage	Othman *et al*. (2015)
23	Wall buckling	Wang [2006]
24	Warping of wooden components	Jaunslavietis *et al.,* (2018)
25	Roof sagging	Mydin *et al*., (2012)
26	Overcrowding and Misuse	Awosho/Alemu, (2023)
27	Termite infestation	[Yacob *et al*., 2022]
28	Inadequate venting	[Lanrewaju and Bonnefoy, 2012]
29	Burs	[Pawan, 2013]
30	Peeling paint	[Lanrewaju, 2012]
31	Shrinkage	[Ali Afzal, Faheem Amad, 2017]
32	Window frame gaps	[Zhang, 2002]
33	Shear crack	[Hong, 2016]

Table 2.3 Causes of building defects

S/N	CAUSES OF BUILDING DEFECTS	SOURCE
1	Environmental factors	Chew *et al*. (2004); Faqih *et al*. (2020).
2	Structural failure	Ahzahar *et al*. (2011); Merah (2021).
3	Water leakage	Chew (2005); (Hassan *et al*., 2011).
5	Poor workmanship	Kubba, 2008; Ahzahar *et al*., 2011
6	Use of substandard material	Chew (2005)
7	Poor drainage system	Gurmu *et al*. (2023).
8	Fire hazard	Johnston & Reid (2019).
9	Inadequate supervision	Pheng and Wee (2001)
10	Poor design	(Kubba, 2008); Salim *et al.* (2016),
11	Faulty/poor construction	Ahzahar *et al*. (2011); (Plebankiewicz & Malara, 2020).
12	Improper roof slope	Alejo (2018).
13	Inefficient HVAC system	(WHO, 2009; Ge *et al*., 2012).
14	Technological issues	Yamov and Belyaeva (2019)
15	Termite infestation	Yacob *et al*. 2022
16	Poor plumbing work	Gurmu & Mudiyanselage (2023).
17	Electrical faults	Ahzahar *et al*. (2011)
18	Poor ventilations	(WHO, 2009; Ge *et al*., 2012).
19	Insufficient reinforcement	Yacob *et al*. 2022
20	Poor concrete	Yacob *et al*. 2022
21	Inappropriate paint selection	Chew (2005)
22	Settlement of structure	Sumitra, [2011]
23	Expansion and contraction	Basel, [2017]
24	Crack in wall	Uday, [2024]
25	Roof leakage	Abby, [2024]
26	Inferior glass installation	Babar, [2024]
27	Chemical attack	Abenhaim, [1992]

28	Poor tilling work	Wong, [2004]
29	Inadequate site preparation	Tom, [2022]
30	Poorly design staircase	Koutamanis, [2024]
31	Vibration damage	OAB Hassan, [2009]
32	Inadequate testing of materials	Olanrewaju, [2024]
33	Miscommunication of site instruction	Abdullah[2024]
34	Environmental issues	Faqih and Solima, [2020]
35	Poor maintenance	Olokpo, [2018]
36	Inadequate risk management	Karim, [2023]
37	Tools limitation	Wellek, [2014]
38	Lack of standard	Othman and Mydin, [2015]
39	Poor maintenance	Alomari, [2022]
40	Incorrect data handling	Ashish, [2002]

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Research Design

Research design provides the overall framework for collecting and analyzing data. This study adopted a quantitative survey design, which is appropriate because it allows the collection of numerical data from a relatively large population of professionals within a short period. Quantitative designs also facilitate statistical analysis, enabling patterns and relationships to be identified objectively.

The survey method was chosen because it is cost-effective, flexible, and suitable for gathering perceptions across diverse groups such as architects, engineers, builders, quantity surveyors, and estate surveyors. The structured questionnaire ensured uniformity in responses, minimizing bias, and making the data amenable to statistical analysis.

3.2 Data Collection

Two main sources of data were utilized:

Primary Data: Obtained through the administration of structured questionnaires to professionals in Benin City. The questionnaire contained closed-ended questions, organized into three sections:

1. **Section A:** Respondents' demographic information (profession, years of experience, sector).

2. **Section B:** Frequency and types of building defects.

3. **Section C:** Causes and strategies for prevention.

Secondary Data: Derived from published books, journal articles, conference proceedings, reports of professional bodies (NIOB, NIA, NSE), and online resources related to building defects. These sources provided theoretical foundations and contextual understanding.

To improve reliability, the questionnaire was pre-tested among 10 professionals in Benin City before the main survey. Feedback from the pilot test was used to adjust ambiguous questions.

3.3 Target Population

The target population comprised professionals within the built environment in Benin City. Based on records from professional bodies and local directories, the estimated population included:

Table 3.1 Target population

S/N	Target Population	Number of Professionals	Percentage (%)	Sample Size
1	Engineers	110	24.28	28
2	Architects	100	22.08	25
3	Quantity Surveyors	108	23.83	27
4	Builders	75	16.56	19
5	Estate Surveyors	60	13.25	15
	TOTAL	**453**	**100%**	**114**

SOURCE: Nigerian Society of Engineers, Nigerian Institute of Architects, Nigerian Institute of Quantity Surveyors, Nigerian Institute of Building and Nigerian Institution of Estate Surveyors and Valuers, Edo State Chapter.

This population was deemed appropriate because these categories are directly involved in design, supervision, construction, and maintenance of buildings, and therefore possess firsthand knowledge of defects and their causes.

Table 3.1 (to be included in Word): Distribution of the target population across professional categories.

3.4 Sampling and Sample Size

Given the large population, it was impractical to survey all professionals. Therefore, Yamane's (1967) simplified formula for sample size determination was applied:

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

Where:

n = sample size

N = population size (453)

e = level of precision (0.09 = 9%)

$$n = \frac{453}{1 + 453(0.09^2)} \approx 114$$

Thus, a sample size of 114 professionals was obtained.

Sampling Technique

A convenience sampling method was employed due to time and resource limitations. This technique allowed easy access to professionals during site meetings, office visits, and professional gatherings in Benin City. Although convenience sampling may introduce bias, its limitations were minimized by ensuring a spread across the five professional categories.

3.5 Data Analysis

Data collected were coded and analyzed using Statistical Package for the Social Sciences (SPSS) Version 26. Two main techniques were applied:

1. Mean Item Score (MIS):

Used to rank the frequency of defects, causes, and strategies. The MIS formula is:

$$MIS = \frac{\sum (f \times w)}{N}$$

Where:

= frequency of response

= weighting assigned to each response (5 = Very Frequent/Strongly Agree … 1 = Not Frequent/Strongly Disagree)

= total number of respondents

An MIS of ≥ 4.0 was interpreted as “high frequency/significance,” while an MIS < 3.0 was interpreted as “low frequency/significance.”

2. Mann-Whitney U Test:

This non-parametric test was used to compare the perceptions of professionals regarding public vs. private buildings. It was chosen because it is suitable for ordinal data and independent samples. Significance was tested at $p < 0.05$.

3.6 Linking Defects and Causes to Research Objectives

The research methodology was directly aligned with the objectives:

- Objective 1 (Identify frequency of defects): Achieved by MIS analysis of Section B of the questionnaire.
- Objective 2 (Compare defects in public and private buildings): Achieved by Mann-Whitney U Test.
- Objective 3 (Analyze causes of defects): Achieved by MIS analysis of Section C.
- Objective 4 (Recommend strategies): Achieved by MIS ranking of preventive measures.

Thus, the methodological design ensured that the research questions were systematically addressed, and the objectives were achieved.

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.0 Introduction

This chapter presents the data collected from the administered questionnaires and analyzes the responses using the Mean Item Score (MIS) and Mann-Whitney U Test. The results are presented in tables and figures, followed by interpretations in relation to existing literature. Out of 114 questionnaires distributed, 102 were retrieved and found usable, representing an 89% response rate.

Table 4.0 General Information On Respondent And Organization

Category	Group	Frequency
Public Sector	Sector	65
Private Sector	Sector	49
Engineers	Profession	22
Architects	Profession	25
Quantity Surveyors	Profession	24
Builders	Profession	30
Estate Surveyors	Profession	13
HND	Academic	29
B.TECH/BSC	Academic	69
MSC/MSC.ARCH	Academic	13
PHD	Academic	0
Others	Academic	3
Less than 5 years	Experience	41
6 â€“ 10 years	Experience	33
11 â€“ 20 years	Experience	37
More than 20 years	Experience	3
Mean Item Score (Experience)	Experience	114

Respondent and Organization Analysis

1. Sector of Employment

Out of 114 total respondents:

- 65 (57.0%) are from the public sector
- 49 (43.0%) are from the private sector

Interpretation: The majority of the respondents are employed in the public sector, indicating that government institutions were more represented in the study.

2. Professional Qualification

Engineers: 22 (19.3%)

Architects: 25 (21.9%)

Quantity Surveyors: 24 (21.1%)

Builders: 30 (26.3%)

Estate Surveyors: 13 (11.4%)

Interpretation: Builders formed the largest professional group among respondents (26.3%), while Estate Surveyors were the least represented.

3. Academic Qualification

HND: 29 respondents (25.4%)

B. Tech / BSc: 69 respondents (60.5%)

MSc / MSc. Arch: 13 respondents (11.4%)

PhD: 0 respondents (0%)

Others: 3 respondents (2.6%)

Interpretation: Most respondents hold a Bachelor's degree (B.Tech/BSc), while no PhD holders participated in the survey. This suggests a strong representation of mid-level academic professionals.

4. Years of Professional Experience (Mean Item Score Analysis)

Less than 5 years: 41 (Weight = 1) -> 41

Respondent and Organization Analysis

6 - 10 years: 33 (Weight = 2) -> 66

11 - 20 years: 37 (Weight = 3) -> 111

More than 20 years: 3 (Weight = 4) -> 12

Total Frequency = 114, Total Score = 230

Mean Item Score (MIS) = 230 ÷ 114 = 2.02

Interpretation: The Mean Item Score (MIS) of 2.02 implies that, on average, respondents have between 6 to 10 years of professional experience, with a slight lean toward the 11-20 years category. This suggests that most of the participants are mid-career professionals with a good level of experience.

4.1 Frequency of Building Defects in Benin City

Respondents were asked to indicate the frequency of occurrence of selected building defects. Table 4.1 summarizes the results.

Table 4.1: Frequency of Building Defects (MIS Ranking)

Defect Type	**MIS**	**Rank**
Cracks in walls/foundations	4.35	1
Peeling paint/finishes	4.19	2
Poor drainage	4.15	3
Roof leaks	3.99	4
Dampness/rising moisture	3.92	5
Plumbing leaks	3.75	6
Electrical faults	3.60	7
Termite attack	3.25	8

Interpretation:

Cracks were ranked highest (MIS = 4.35), suggesting that structural instability and foundation problems are the most common defects in Benin City. This aligns with Enoma & Idehen (2018), who reported that differential settlement is prevalent in poorly supervised buildings. Peeling finishes and roof leaks also emerged as recurring issues, reflecting poor workmanship and inadequate material quality.

4.2 Causes of Building Defects

Professionals were asked to rate the significance of various causes of defects. Results are shown in Table 4.2.

Table 4.2: Causes of Building Defects (MIS Ranking)

Cause of Defects	**MIS**	**Rank**
Substandard materials	4.38	1
Inadequate supervision	4.31	2
Poor workmanship	4.31	3
Weak regulatory enforcement	4.25	4
Poor design/planning	4.10	5
Lack of maintenance	3.95	6
Environmental conditions	3.70	7

Interpretation:

The use of substandard materials ranked highest (MIS = 4.38). This finding is consistent with Faremi *et al*. (2020), who highlighted adulterated cement and inferior reinforcement steel as major contributors to failures in Nigeria. Inadequate supervision and poor workmanship also ranked very high, underscoring systemic challenges in project delivery.

4.3 Strategies for Prevention of Building Defects

Respondents were asked to suggest effective strategies for minimizing defects. The results are summarized in Table 4.3.

Table 4.3: Strategies for Prevention (MIS Ranking)

Strategy	**MIS**	**Rank**
Adoption of BIM & smart monitoring	4.60	1
Use of certified quality materials	4.46	2
Regular supervision & inspections	4.41	3
Continuous training of artisans	4.36	4
Preventive maintenance culture	4.25	5
Strict enforcement of codes	4.20	6

Interpretation:

Professionals overwhelmingly supported the adoption of modern technologies such as Building Information Modelling (BIM), drones, and sensors to monitor quality in real-time. This finding reflects global trends where digital tools are increasingly used to reduce errors and enhance performance. However, traditional measures such as supervision, training, and material certification also remain vital.

4.4 Comparison of Defects in Public vs. Private Buildings

The Mann-Whitney U Test was applied to determine whether differences existed between public and private buildings in the occurrence of defects.

Table 4.4: Mann-Whitney U Test Results

Defect Type	**U-Value**	**p-Value**
Cracks	1250.5	0.142
Roof leaks	1302.0	0.275
Dampness	1275.3	0.183
Termite attack	1118.4	0.035

Interpretation:

The results show no significant difference between public and private buildings in most defect categories, indicating that both sectors suffer equally. The only significant difference was in termite infestation ($p = 0.035$), which was found to be more common in low-cost private housing projects than in public facilities.

4.5 Discussion of Findings

The findings confirm that:

- Defects are widespread in Benin City, with cracks, peeling finishes, and leaks being most frequent.
- Substandard materials, poor workmanship, and inadequate supervision are systemic causes, aligning with past studies (Isa *et al*., 2016; Faremi *et al*., 2020).
- Both public and private sectors are affected, though private housing shows higher susceptibility to environmental defects.
- BIM and quality control are viewed as the most effective strategies for prevention, reflecting the growing global reliance on digital construction technologies.

CHAPTER FIVE

RECOMMENDATIONS AND CONCLUSION

5.0 Introduction

This chapter summarizes the key findings of the study and provides actionable recommendations aimed at minimizing building defects in Benin City. The recommendations are structured for stakeholders such as government regulators, construction professionals, developers, and end users.

5.1 Recommendations

Based on the findings of this study, the following recommendations are made:

5.1.1 Enforcement of Building Codes and Standards

There should be stricter enforcement of existing building codes and standards in Benin City. Regulatory bodies such as the Development Control Department of the Ministry of Physical Planning should conduct routine site inspections. Contractors found guilty of using substandard materials or deviating from approved designs should be sanctioned. Furthermore, regulatory frameworks should be updated regularly to align with global best practices.

5.1.2 Strengthening Supervision and Quality Control

Adequate supervision at every stage of construction is essential. Consultants and professional builders should be engaged to ensure that specifications are strictly followed. Quality control measures such as material testing, site audits, and peer reviews should be institutionalized. For example, reinforcement steel, cement, and aggregates should undergo laboratory testing before use.

5.1.3 Use of Certified Materials Only

The government should establish accredited suppliers and testing laboratories for construction materials. Developers should insist on certified materials with proof of quality assurance. The Standards Organization of Nigeria (SON) and other agencies must intensify monitoring of building materials in the market to eliminate counterfeit and substandard products.

5.1.4 Institutionalization of Preventive Maintenance

A culture of preventive maintenance should be adopted. Building owners and facility managers should conduct periodic inspections and address defects early before they escalate. Preventive maintenance schedules should be integrated into public building management systems, particularly schools, hospitals, and offices.

5.1.5 Continuous Professional Training

Capacity building is critical. Professional bodies such as the Nigerian Institute of Building (NIOB), Nigerian Institute of Architects (NIA), and Nigerian Society of Engineers (NSE) should organize regular training, workshops, and certifications for professionals and artisans. This will improve technical competence and reduce errors in workmanship.

5.1.6 Adoption of Modern Technologies (BIM and Smart Tools)

Digital technologies such as Building Information Modelling (BIM), drones for site monitoring, and smart sensors for detecting moisture and structural stress should be integrated into the Nigerian construction industry. BIM can significantly reduce design errors and improve coordination among professionals. Government should encourage adoption by offering tax incentives or subsidies for technology-driven construction projects.

5.1.7 Collaborative Efforts among Stakeholders

Successful minimization of defects requires synergy among government regulators, contractors, consultants, developers, and end users. Stakeholders should share information and collaborate to ensure compliance and quality delivery. For example, public-private partnerships (PPPs) can be established to provide affordable but defect-free housing.

5.2 Conclusion

This study has shown that building defects are pervasive in Benin City, threatening safety, durability, and user satisfaction. Cracks, roof leaks, poor drainage, and peeling finishes were found to be the most frequent defects. The main causes include the use of substandard materials, inadequate supervision, poor workmanship, and weak regulatory enforcement.

The analysis further revealed that both public and private buildings suffer similar defects, highlighting systemic challenges in Nigeria’s construction sector. Preventive measures such as the adoption of BIM, use of certified materials, strict supervision, and continuous training were identified as effective strategies to minimize defects.

If these strategies are implemented, Benin City will experience safer, more durable, and sustainable buildings. This will not only protect lives and property but also improve the economic and social well-being of residents.

REFERENCES

Ahzahar, N., Karim, N. A., Hassan, S. H., & Eman, J. (2011). A study of contribution factors to building failures and defects in construction industry. *Procedia Engineering*, *20*, 249-255.

Alfano, F. R., *et al*. (2023). Moisture-related defects in tropical housing. *Journal of Building Pathology,* **12**(2):101–115.

Awasho, T., & Alemu, B. (2023). Building maintenance culture and its challenges in developing countries. *Construction Research Journal*, **18**(1):77–89.

Awol, A., Adugna, T., & Mosisa, A. (2016). Assessment on causes of defect and the maintenance management practices on low cost building (A case study of Jimma Town Condominium). *International Journal of Engineering and Technical Research*, *5*(3), 151-156.

Che-Ani, A. I., Che-Ani, A. I., Johar, S., Mohamad-Idin, M. A., Abdullah, M. F., & Maruzuki, M. I. F. (2015). Development of transduction circuit for flat roof water ponding monitoring system using etape sensor. *Journal of Engineering Science and Technology*, *10*(Spec. Issue on 4th International Technical Conference (ITC) 2014), 24-34.

Enoma, A., & Idehen, J. (2018). Prevalence of defects in public buildings in Edo State. *Nigerian Journal of Construction*, **5**(3):44–58.

Faremi, A. O., *et al*. (2020). Substandard materials and building failure in Nigeria. *Nigerian Institute of Building Conference Proceedings*, **2**(1):55–63.

Grondzik, W. T., & Kwok, A. G. (2019). *Mechanical and Electrical Equipment for Buildings* (13th ed.). Hoboken, NJ: John Wiley & Sons.

Hasanain, M. A., Sanni-Anibire, M. O., & Al-Hammad, A. M. (2016). *Post-Occupancy Evaluation of Housing Facilities: Overview and Summary of Methods*. Journal of Performance of Constructed Facilities, 30(5), 04016045.

Isa, R., *et al*. (2016). Defects in construction: Causes and remedies. *Journal of Engineering Studies*, **14**(2):88–101.

Ismail, I., Ani, A. I. C., Razak, M. Z. A., Tawil, N. M., & Johar, S. (2015). Common building defects in new terrace houses. *Jurnal Teknologi*, *75*(9), 83-88. https://doi.org/10.11113/jt.v75.5239

Jamaluddin, N., Yeoh, D., Ghani, A. H. A., Boon, K. H., Ayob, S. S., Ibrahim, M. H. W., Mohamad, N., Chik, T. N. T., & Nor, N. H. (2018). A case study of residential buildings subjected to cracking failures. *International Journal of Integrated Engineering*, *10*(2), 118-122. https://doi. org/10.30880/ijie.2018.10.02.022

Johnston N., and Reid S. (2019). An Examination if Building Defects in residential Multi-Owned Properties. Deakin University. orcid.org/0000-0002-9450- 7034

Latip, N. A., Umar, M. U., Noriman, N. Z., Johari, I., Dahham, O. S., Hamzah, R., & Nazri, S. (2020). Current method on spalling repair work in ages building. *AIP Conference Proceedings*, *2213*(March). https: //doi.org/10.1063/5.0000409

Olanrewaju, A., & Abdulaziz, A. (2015). Building maintenance processes and practices. Springer.

Omar Bakri, N. N., & Othuman Mydin, M. A. (2014). General building defects: Causes, symptoms and remedial work. *European Journal of Technology and Design*, *3*(1), 4-17. https://doi.org/10.13187/ejtd.2014.3.4

Salim, N. A. A., Salleh, N. M., & Zahari, N. F. (2016). Design failure affecting maintenance management on public higher

Sravani T. D. S. (2020). Assessment on various construction defects and possible solutions of a building. *Journal of Critical Reviews*, *7*(18), 4239-4245. https://doi.org/10.31838/ jcr.07.18.521

Talib, H., & Sulieman, M. (2020). Environmental impact on building performance. *International Journal of Sustainable Construction*, **9**(1):65–78.

Talib, R., & Sulieman, M. Z. (2020). *Factor effecting typical interior defects found in Malaysian building*. 1-18.

Wood, A., & Swan, B. (2015). *Post-occupancy evaluation and defect studies in developed countries*. In S. Wilkinson & R. Dixon (Eds.), Building Surveyor's Reports and Defects (pp. 145–160). Routledge.

Yacob, S., Ali, A. S., Au-Yong, C. P. (2022). Factors Contributing to Building Defects. *Managing Building Deterioration: Prediction Model for Public Schools in Developing Countries*, 41-63.

Yamov, V., & Belyaeva, Z. (2019). Analysis of main causes of defects of multi-storey reinforced concrete frame buildings. *MATEC Web of Conferences*, *279*, 02008. https:// doi.org/10.1051/matecconf/201927902008

Yoon, J., *et al*. (2021). Post-occupancy evaluation and defects in housing. *Building Research & Information*, **49**(5):556–570.

DEPARTMENT OF QUANTITY SURVEYING

FACULTY OF ENVIRONMENTAL SCIENCES

UNIVERSITY OF BENIN, BENIN CITY, EDO STATE

Dear Respondent,

QUESTIONNAIRE ON BUILT ENVIRONMENT PROFESSIONALS' PERCEPTION OF BUILDING DEFECTS IN BENIN CITY, EDO STATE, NIGERIA

This is to respectful request you to kindly fill out the attached questionnaire.

I am undertaking a research on "**Built Environment Professionals' Perception of Building Defects in Benin City, Edo State, Nigeria"** as part of the requirements for the award of post-graduate diploma (PGD) degree in Construction Management.

The study seeks to investigate causes and frequency of building defects, and how defects could be minimized in public and private sector construction projects.

The survey is purely meant for academic purposes and I wish to assure you that all information provided will be treated as confidential.

Yours faithfully,

OSAYANDE, Ukpebor

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INSTRUCTION: Please, respond to each question below to the best of your knowledge. Multiple choices are allowed where appropriate. Your response should be based on a recently completed major project.

SECTION A- GENERAL INFORMATION ON RESPONDENT AND ORGANIZATION

1. In which sector is the referent project?

Public [ ]

Private [ ]

2. Profession of respondent

(a). Architect [ ] (b) Quantity Surveyor [ ] (c) Engineer [ ] (d) Builder [ ] (e) Estate Surveyor and Valuer[ ] ___________

3. Academic qualification of respondent

(a).HND [ ] (b) B.Tech/B.Sc. [ ] (c)M.Sc./M.Arch [ ] (d) Ph.D. [ ] (e) Others (PleaseSpecify)...

4. Indicate your years of professional experience?

(a). Less than 5years [ ] (b) 6-10 years [ ] (c) 11-20years [ ] (d) more than 20years [ ]

SECTION B:

Table 1: Kindly rate the frequency of occurrence of the types of defects found in buildings in Benin City using the scale: 5-Very high, 4- High, 3- Moderate, 2- Low, 1- Very low

S/N	Most common types of defects found in Building	Very high (5)	High (4)	Moderate (3)	Low (2)	Very Low (1)
1	Cracks in walls/foundations					
2	Roof leaks water damage					
3	Dampness or moisture problems					
4	Electrical faults or failure					
5	Poor finishing					
6	Plumbing defects					
7	Poor workmanship or craftsmanship					
8	Inadequate or faulty materials					
9	Environmental or health hazards (e.g., mold, asbestos)					
10	Rot and mold					
11	Clogging					
12	Stretching and tearing					
13	Blistering					
14	Distortion					
15	Bending/sagging moment					
16	Condensation					
17	Porosity					
18	Inadequate venting					

19	Uneven plastering					
20	Poor drainage					
21	Wall buckling					
22	Warping of wood components					
23	Roof sagging					
24	Termites infestation					
25	Burs					
26	Peeling paint					
27	Shrinkage					
28	Window frame gap					
29	Shear crack					
30	Water ponding					
31	Installation error					
32	Spalling of concrete					
33	Honeycombing in concrete					
34	Buckling of column					
35	Over loading circuit					
36	Differential settlement of foundation					
37	Improper load distribution					
38	Light painting					
39	Uneven tiling					

Table 3: Kindly rate the following suggested causes of defects in buildings in Benin City

5-Strongly agree 4- agree 3- moderately agree 2- disagree1- Strongly disagree

S/N	Causes of defects in buildings	**S.A (5)**	**A (4)**	**M.A (3)**	**D.A (2)**	**S.D.A (1)**
1.	Substandard materials					
2.	Poor workmanship					
3.	Inadequate supervision					
4.	Design flaws					
5.	Overloading/Change of use					
6.	Environmental conditions e.g. Weathering; Natural disasters; Soil settlement					
7.	Age of the building					
8.	Lack of maintenance					
9.	Negligence					
10.	Inadequate repairs					
11.	Poor drainage system					
12.	Faulty/poor construction					
13.	Poor designs					
14.	Termites infestation					
15.	Poor plumbing					
16.	Technological issues					
17.	Inappropriate paint selection					
18.	Improper roof slope					
19.	Fire hazard					

20.	Faulty/poor construction					
21.	Electrical faults					
22.	Settlement of structure					
23.	Expansion and contraction					
24.	Cracks in wall					
25.	Roof leakage					
26.	Inferior glass installation					
27.	Chemical attack					
28.	Poor tilling work					
29.	Inadequate site preparation					
30.	Poorly design staircase					
31.	Vibration damage					
32.	Inadequate testing of building materials					
33.	Miscommunication of site instruction					
34.	Environmental factors					
35.	Poor maintenance of facilities					
36.	Inadequate risk management					
37.	Tools limitation					
38.	Lack of standard					
39.	Poor maintenance culture					
40.	Incorrect data handling					

Table 4: Please indicate the strategies for mitigating building defects in the study area using the Likert scale below:

5-Strongly agree 4- agree 3- moderately agree 2- disagree1- Strongly disagree

S/N	**Strategies to mitigate the causes of defects**	**S.A (5)**	**A (4)**	**M.A (3)**	**D.A (2)**	**S.D.A (1)**
1	Create detailed digital models of the building to identify potential defects.(BIM)					
2	Analyze the building's structural integrity to identify potential weaknesses.					
3	Choose materials that are suitable for the building's purpose and environment.					
4	Design the building with sustainability in mind to reduce the risk of defects.					
5	Implement quality control measures:					
6	Provide training to construction personnel					
7	Use of experienced contractors					
8	Monitor construction progress					
9	Specify high-quality materials					
10	Design for environmental factors:					
11	Use technology, such as sensors and monitoring systems, to detect potential defects.					
12	Continuously monitor and evaluate the building's condition to identify potential defects.					

APPENDICES

Appendix A: Sample Questionnaire

Appendix B: SPSS Output Tables

Appendix C: Additional Charts (e.g., MIS distribution graphs)