

**ASSESSMENT OF THE CAUSES AND EFFECTS OF  
BUILDING DEFECTS ON THE PERFORMANCE OF  
THE NIGERIAN CONSTRUCTION INDUSTRY**

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NATIONAL DIPLOMA IN QUANTITY SURVEYING**

**BY**

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**CERTIFICATION**

This is to certify that “**ASSESSMENT OF THE CAUSES AND EFFECTS OF BUILDING DEFECTS ON THE PERFORMANCE OF THE NIGERIAN CONSTRUCTION INDUSTRY**” was undertaken by **OBICHUKWU FAVOUR** in the department of Quantity Surveying, Auchi Polytechnic Auchi

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## **DEDICATION**

The project is dedicated to my God almighty; the source of wisdom and knowledge and giving me the opportunity of life to do this work successfully

## **ACKNOWLEDGEMENT**

Gratitude to Almighty God for his mercy, Grace, guidance, provision and protection for being the reason of my existence. Appreciation goes to my parent Mr. and Mrs Christiopher Obichukwu and my lovely Brother and Sisters, Lilian, Festus and Precious for their financial and moral support, I express my profound gratitude to my supervisor Mr. Sumanu S.O. for is immeasurable advise and constructive criticism to the success of this work. In addition I will not fail to express my sincere gratitude to the staff of quantity Surveying Department; the HOD QS. Felix Uwadia, QS. Olusola Bejide, Mrs. Amiebenomo, QS Mrs. Eigbe Bridget, QS. Oso, QS. Idowu, QS Yusuf, QS Usman and others who has been a source of encouragement in one way or the other to make sure this dream comes to fulfillment, May God in his infinite Mercy Bless you all.

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## **ABSTRACT**

*The rate of construction project accomplishment is weak because of the rapid increasing rate of major defects in building as a result of poor workmanship and poor quality materials which have been identified as the major cause of defects in the construction industry. This paper aims to investigate the assessment of the causes and effects of building defects on the performance of the Nigerian construction industry. The objectives of this study are to investigate common building defects that mostly occur at housing projects due to poor workmanship, the factors that contribute to poor workmanship, its impact on the project performance and to established possible measures to minimize these problems. After relevant literatures were reviewed both primary and secondary data collected through questionnaire, observation and case study. The causes for building defects that mostly occur due to poor design, failure of the material, poor workmanship and lack of maintenance. Major impacts of defect due to poor workmanship were project cost overrun and project delay. These significant impediments can be remedied by providing suitable construction management, giving training and education to the laborers as well as implementing strict supervision during construction work. The study also forwarded recommendations in line with the need of further study and continuous capacity building mainly for micro scale enterprises based on impact assessment. Improvements on all project management phases need to be done by amend the existing contractual document including specification and guidelines with the nature of building projects.*

## CHAPTER ONE

### 1.1 Background of the Study

The construction industry plays an essential role in the economic development of any developing nation (Kheni, Gibb & Dainty, 2018), and especially in an expanding economy like Nigeria (Ibironke, 2013; Shittu & Shehu 2016). Okeola (2019) averred that at least 50% of the investment in various development plans is primarily in construction and the industry is the next employer of labour after agriculture in underdeveloped countries. The construction industry in Nigeria generates almost 70% of the nation's fixed capital formation, in spite of that, its performance within the economy is very poor (Federal Office of Statistics, Abuja as cited in Arazi & Mahmoud, 2015).

The last decade however exposed the declining level of clients' satisfaction from the built facilities as a result of poor quality performance in addition to the perennial problems of time and cost overruns in the Nigerian construction industry (Arazi & Mahmoud, 2015). Defective construction is not limited to developing economies alone. Pole (2017) stressed that there had been claims of defective construction in the California housing market which focused on the development of condominium subdivisions; this also resulted to a rapid increase of "construction defects litigation" since the "boom" of the 1980's". This is a proof of the existence of the problem of defective construction in developed counties. It is however not astonishing that it is a significant challenge found in the Nigerian building industry. "Defective construction work can be as a result of inadequate design, faulty workmanship or poor materials – or some combination of these failings. Someone is actually to blame, either the builder (or artisan) or one or more of the professional consultants, or even the entire project team.

It is important therefore that the project team should possess a good working knowledge of their responsibilities and liabilities” (Barrett, 2018).

In construction projects the nature and type of defects can vary strikingly, as can the point at which they become obvious or readily perceived (Outlaw, 2011). Sometimes minor defects can simply be corrected before the building is handed over to the employer, at other times significant defects may occur long after the original work has been finished and require large remedial works to repair. In instances where these defects are abandoned on account of being unnoticed or they are beyond correction, such buildings are left to the clients or users to maintain, endure the unpleasant aesthetics, and risk possible failures in very terrible cases (Outlaw, 2011).

In the entire lifecycle of any building, defective construction can be both a bane and a burden to that building, its users and its neighbourhood. Generally, this deficiency can be traced to design errors, poor or inferior materials, supervision lapses, and the incompetence of artisans. Sometimes, designers may not be conscious of the implication of their design decisions and the ability of contractors to meet or fulfill them safely. The client or contractors are sometimes culpable of the procurement of poor building materials. During construction, supervision which helps in resolving certain misinterpretations and unprofessionalism is sometimes needlessly insufficient. The contractors and artisans who bring the designer’s dream to reality are either incompetent, looking for the easiest way out, or in haste in order to create time and clinch other contracts. In the construction stage, these delinquencies affect the cost and time of construction because such works have to be revisited. During use, such buildings are left to the clients to grapple with and maintain. As a result, Nigerians lack confidence in indigenous professionals, therefore they invite expatriates to design and build for them.

This study evaluates issues relating to defective construction works as it results from deficiencies from the design and construction teams. Attempts were made to emphasize the essence of avoiding defective works and the role of supervision and quality control during construction in alleviating the incidence of defective works in buildings. Hence the study proposes to look at the visual defects in buildings, their causes and the causes and effects on the performance of the Nigeria Construction industry.

## **1.2 Statement of the Research Problem**

The performance of any construction project be it public or private depends on the strategy for success adopted by the organization responsible for its implementation and execution. The strategies for success in any construction project are implemented in the management of the project time, cost, quality and material. In most cases, both public and private construction company in Nigeria are hardly completed on time, within cost, quality and material specifications. New construction projects and newly rehabilitated or maintained infrastructure become decrepit and wrecked within a few months of commissioning despite the capital commitment on them. Defects of building facilities during construction in Nigeria can best be described as a holistic financial loss. Construction project failure, abandonment and defect does not encourage development and investment.

Therefore, this study focuses on investigating common building defects due to poor workmanship and assessing factors that contribute to poor workmanship with a goal of establishing possible measures to overcome such challenges in the Nigerian building sector.

### **1.3 Research Questions**

In an attempt to achieve the aim of the study, the following research questions are proposed:

- ❖ What are the major causes of building defects in the Nigerian constructions industry?
- ❖ What are the effects of building defects on the Nigerian construction sector?
- ❖ What are the measures that could be adopted in mitigating the effects of building defects in the Nigerian building industry?

### **1.4 Aim and Objectives of the Study**

The aim of the study is to assess the causes and effects of building defects on the performance of the Nigerian construction industry with a view to enhancing the overall quality of construction projects in the industry

#### **Specific Objectives**

In order to achieve the aim of the study, the specific objectives are as follows:

- ❖ To identify the major causes of building defects in the Nigerian construction industry
- ❖ To examine the effects of building defects on the Nigerian Construction Sector
- ❖ To evaluate the measures that could be adopted in mitigating the effects of building defects in the Nigerian building industry?

### **1.5 Justification for the Study**

Defects according to Harris (2016) are faults that may reduce the durability, usefulness, or strength of a construction work. They are the unacceptable quality of a project which can be identified and remedied. Atkinson (2018) defines defective construction works

as those which fall short of complying with the specific descriptions or requirements of the contract, especially any drawings or specifications, together with any implied terms and conditions as to its quality, workmanship, durability, aesthetics, performance or design.

More importantly, in considering 'defects' as a matter of principle, work may be defective even if it has been carried out with all due skill and care but it fails to satisfy or meet a particular specification. For example, brickwork may be erected correctly but the wrong type or colour of brick could have been used in breach of planning permission (Outlaw, 2011). A construction defect, as defined by California Jury Instructions and cited by Pole (2017) is the: "failure of the building or any building component to be erected in a reasonably workmanlike

manner or to perform in the manner intended by the manufacturer or reasonably expected by the buyer, which proximately causes damage to the structure." Furthermore, the California State Assembly Bill, AB 2959, as cited in Pole (2017) stated that a construction defect would result from: Defective building materials or components, a violation of Building Codes at the time of construction, failure to meet professional standards for design at the time plans was approved and failure to build according to accepted trade standards for good and workmanlike construction.

Building industry is an important sector that contributes greatly in the economic growth of a nation. The Building industry is an investment-led sector where government and public show high interest. Government and Public contracts with Building Industry to develop infrastructure related to health and education sector.

Finally, the researchers' opinion is that: construction defects refer to those flaws in the physical structure of a building that may occur in any element of the building and interferes with the aesthetics, durability and structural stability of the building. They

include cracked walls, sloping floors, poor finishing, uneven staircase threads and risers, beams and columns that are not perfectly horizontal or vertical, and the likes.

### **1.6 Scope of the Study**

This study is aimed at investigating the causes and effects of building defects on the building performance of the Nigeria Construction Industry. The scope of the study is limited to Edo State located in the south-south geo-political zone of Nigeria. The scope of the study also cover all categories of building and construction projects within the Study Area.

## CHAPTER TWO

### LITERATURE REVIEW

#### 2.1 Introduction

Ojo and Ijatuyi (2015) defined defects as “faults, which may reduce the strength of a construction work, durability or usefulness”. It is among the most common problems that construction projects suffer from. (Chan, A and Chan, A. 2014) found that “most of the defects due to human factors were caused solely by ‘forgetfulness and carelessness,’ 29% by lack of knowledge, and a very small percentage were intentional. As for workmanship defects, lack of motivation dominated the costs, but the presence of risks directly increased the chance of defects.”

Carelessness has been stated to be the most important cause of construction defects. (Jingmond and Ågren 2018) conducted a study to identify primary root causes of defects and found that the causes of defects mainly reside in endogenous factors within the organizations. According to (Waziri 2014), it was noticed that many building defects could be explained entirely or partly because of readily identifiable errors in construction, which could have been foreseen and hence avoided. The importance of different defects arising from construction process has been established and identified as critical to the maintenance of residential building. The topmost defects have been determined to be: poor construction work supervision, use of defective construction materials, poor site quality control, defects due to specification and use of untested and new materials and incompetent workforce for construction. However, (Ahzahar 2014) found that low quality of construction materials is the most common factor that leads to the building defects and failures. (Bakri and Mydin 2018) divided the defects into two main categories; these categories are structural defect and nonstructural defect.

Structural defect means any defect in a structural element of a building that is attributed to defective material, defective or faulty workmanship, defective design and sometimes any combination of these. The structure of building includes columns, earth retaining walls, flat slabs and beams.

Structural defects can be categorized as cracks in walls (superstructure), cracks in foundations (substructure) and cracks in floor or slabs (superstructure). These defects can result from inadequate soil analysis, use of defective materials and inappropriate site selection. However, nonstructural defect in a residential building is defined as a defect in a nonstructural element of the building because of defective residential building work. Nonstructural defect includes defect in plaster works, dampness in old structures and defects in brickwork.

According to (Al-Farra 20-14), the other source of the high cost of maintenance process is the defaults in construction phase, which may be due to many factors such as contractor performance, nonuse of appropriate materials, poor supervision and ineffective use of equipment. As known, the construction environment is constantly changing, and the authorities' actions continuously give new conditions. Simultaneously, competition between companies may become a stronger factor that leads the contractor to accept the bid with low margin of profit. Studies show that the construction defects cost is in the range of 5–10% of the production cost. Therefore, knowledge of the causes of these defects is necessary for choosing adequate measures.

Construction defects due to (Waziri 2014) arise from several factors, which could be visible to the naked eye or deep hidden within the structure. Construction defects that affect directly the structure performance can be a result of defective design or defective construction. Generally, the construction can be as a design that fails to meet the professional standard and a decision that is not in accordance with codes, among

others. Construction failures and defects also may result from poor and misguided decisions of the clients or failure of the design professional to produce complete and accurate design and construction documents, which provide sufficient information for the contractor for building construction. Sometimes, they can be due to the use of nonconforming materials, poor workmanship and design misinterpretation.

According to Assaf *et al.*, ( 2015), defects in the construction stage include

- i.** Defects due to construction inspection based on unqualified inspector, lack of inspection, weakened inspection rule in implementing corrective actions during job execution and proponent (owner) negligence of the importance of inspection;
- ii.** Defects due to civil construction based on inaccurate measurement, damaged formwork, excavation tools close to the building, painting in unsuitable conditions or on unsuitable surface, inadequate waterproofing and drainage, insufficient reinforcement concrete cover, cold joints, loss in adhesion between materials, early formwork removal, poor soil compaction, inadequate curing and lack of communication
- iii.** Defects due to specification based on unclear specification, not defining adequate materials, not specifying the QA/QC construction procedure, not specifying the allowable load limits and specifying inadequate concrete mix design
- iv.** Defects due to contractor administration based on not complying with specification, insufficient site supervision, poor communication with the design firm and the owner, unqualified supervision, speedy completion or poor-quality work, unqualified workforce and multinational construction experience
- v.** Defects due to construction material based on differential thermal movements in dissimilar materials, selection of material that is unsuitable for existing climatic

conditions, use of nondurable material, use of expired material and poor materials handling storage

- vi. Defects due to construction equipment based on improper use of equipment, inadequate performance of equipment and lack of required items of equipment.

## **2.2 Definitions and Concepts of Construction Defect**

### **2.2.1 Definition of Defect**

In general terms, defects or defective work occurs when the standard and quality of workmanship and materials, as specified in the contract, are deficient. Defects may occur in any part of a construction project and at any stage of construction. A defect is defined as 'the non-fulfillment of intended usage requirements' in which requirements are determined by law, regulations, building standards as well as in contract documents, site meeting records and other project documentation (Atkinson, 2019).

According to Watt (2018), post-handover defects on a building defect can be considered a failing or shortcoming in the function, performance, statutory or user requirements of a building and it might manifest itself within the structure, fabric, services or other facilities of the affected building. An immediate way to reduce and/or eliminate post-handover defects is to ensure that quality controls and inspections are implemented during design and construction.

### **2.2.2 Construction Defect**

A construction defect is generally defined as a defect or deficiency in the design, the construction, and/or in the materials or systems used on a project that may not be readily observable and results in a building, structure or component that is not suitable for the purpose intended.

In considering issues within the defect domain, it is important to define what constitutes faults, failure and defects, and what types of failures are evident. The Building Regulations and British Standards do not differentiate between faults and failures and define these as: Fault: A departure from design requirements where these were not themselves at fault. Failure is defined as deviation from original specifications which can or cannot be corrected prior to the handing over of the building. On the other hand, defect is termed as deficiency of the performance, which becomes apparent once the building is operational. Failing to differentiate the two terms may lead to inaccurate and incomplete measurements, cost determination and perhaps inappropriate methods to reduce its occurrence (Atkinson, 2019). Therefore, the term “construction defect” is broader than just defective construction. The term "construction defect" includes both defects during design (i.e faults during design) and defects under construction (i.e failures during construction) that result in financial harm to the owner (Frank, 2013).

### **I. Design defects**

A design defect is typically the result of the design professional’s failure to produce a complete, accurate and well-coordinated set of design and construction documents. These design defects are categorized as a design error or omission and/or a combination of both.

A design error is defined as a mistake in the design where the design element was either constructed or under construction and required retrofitting and/or replacement of any component to correct the error. Under these circumstances, the entire cost of the change is attributable to the design profession as a result of its design error.

A design omission is defined as the scope that was either missed and/or omitted by

the design professional in its design and construction documents but was later discovered and added to the scope of work by a change order. A design omission also includes design items that were incorrect, but were corrected after award of the project and before the construction process was materially affected. Typically, it is understood that some premium costs over and above the actual cost of the changed work are paid for the work that was not competitively priced. These additional costs are directly attributable to the design professional as an omission (Frank, 2013).

## **II. Defects in construction**

Defective construction works can be defined as works that fall short of complying with the express descriptions or requirements of the contract. The majority of modern buildings and civil structures are complex and involve the use of a great variety of engineering methods and processes. Defective construction contributes to both the final cost of a project and the cost of maintenance, which can be substantial. Therefore; most projects face the possibility of defects and defective work, which generally result in structures that cannot perform their originally intended roles (Ojo, 2013).

According to Georgiou (2014), Defective construction includes activities such as compaction not done to specifications, which leads to ground movement and eventual failure of foundations. This may lead to the complete failure of a structure. He classified defects into two main categories, namely patent defects and latent defects.

**i. Latent defects:** those defects that are concealed and are often not obvious or readily observable upon reasonable inspection. Even with the most comprehensive on-site inspections, sometimes defective construction may go unnoticed. After

construction is complete, latent defects are unknown and generally undiscoverable and will only appear after the passage of time. Examples of latent defects are: soils that were not properly compacted, improperly installed flashing and/or the total lack of flashing within the building envelope assembly, lack of reinforcing in structural concrete footings, walls and/or slabs, lack of brick ties and/or masonry reinforcement in a brick/masonry veneer wall, an improperly installed weatherproofing system, improperly installed stucco exterior wall system, improperly consolidated concrete, reinforcement not fully embedded in the concrete structure.

**ii. Patent defects:** are the defects that are known or would be readily obvious upon reasonable inspection. Examples of patent defects are: weep holes not installed in brick veneer walls. , handrails omitted in stairways, missing control and/or expansion joints, cracking and/or signs of distress in the building envelope, lack of roof drainage and/or roof slope, lack of proper roof/attic ventilation.

### **2.3 Methods of Building Construction Defect Detection**

Construction defects usually include any deficiency in the performing of the design, planning, supervision, inspection, construction, or observation of construction of any new home or building. The building is deficient if there is a failure during construction – in other words, if the building does not perform in a manner that was intended by the buyer. According to Frank (2011), construction defect detection can be classified into three based on the time to be happening during the construction process.

#### **2.3.1 Pre-construction Stage**

One of the major causes of construction defects is designed inadequacy. This could

happen due to inadequate data about the project site as a result of site investigation problems or due to professional's inadequacy. Site exploration (investigation) problems could arise due to uncomfortable site conditions for exploration or lack of well skilled man power and equipment. The exaggerated cost of exploration is also another problem.

Therefore, the design inadequacy of the service installation materials, substructure and superstructure of a building may lead to serviceability problems or worse to instability. Serviceability deficiency could arise due to problems with the structure or service installation. Inadequate design of sanitary pipes or drains such as the insufficient diameter of drains bends being too sharp, can lead to excessive pressure built up in the pipes causing failure. Serviceability defects with the structure include cracks, deflections, vibrations, etc. These can simply be reduced by fulfilling the requirements of building standards such as EBCS 95/ Euro cod. Detailed preliminary study and site exploration is necessary for consideration of site condition in the design, as such field (In situ) exploration and tests and laboratory tests shall be conducted with necessary equipment and qualified professionals.

### **2.3.2 During Construction Stage**

Construction techniques that may not be defect free, inconsistent or substandard workmanship, and use of unsuitable construction details can lead to shortly occur or long list defects. The large varieties of building materials may not be well similar to one another or under quality materials below the specified standards. Extreme site conditions may undermine performance standards during construction.

Thus, the use of standard materials helps in reducing defects caused due to inferior building materials. For example, for well-proportioned mix ratio selection of

aggregates that are hard, rough, mineral free and well graded maintains the required strength, density, porosity, workability and curing time of concrete for the intended purpose. Thus, problems such as cracks caused due to shrinkage and/or overstressing can be held within limits. Leakage of slab floor, delaminating or worse collapse due to low concrete quality can be controlled.

Defects caused due to bad workmanship should be controlled as they can easily be avoided. Hence, problems caused due to low technical skills such as in concrete production mixture segregation leading to low concrete quality/strength, loose tie of reinforcement bars causing misplacement of the bars leading to over stressing of the structure. Service installation materials, fitting problem are also caused due to error workmanship. Fitting problems, inadequate design of sanitary pipes can lead to leakage, electrical installation problems and improper filings around windows and door frames are also caused due to bad workmanship. These problems can easily be avoided by monitoring the works closely and enhancing technical skills of the labor and providing good working condition.

Good construction management and technical skills are necessary to avoid unnecessary contamination and wastage of construction materials. Good management also helps in controlling workmanship errors, hence, avoiding defects caused due to bad workmanship. For example organized on-site material management and storage system can avoid contamination of materials such as corrosion of steel or mineral attack of aggregates due to storing areas top soil. This avoids problems caused due to corroded steel material; once it is used as a reinforcing material for the steel cannot overcome the tensile stress on the reinforced concrete structure and leading to overstressing of the structure, structural cracks may

occur undermining the stability of the whole structure. The spalling of the concrete cover may also occur due to the corroded steel making the concrete structure more susceptible to carbonation, seriously affecting the strength of the material.

### **2.3.3 Post-construction stage**

Abuse or misuse of the building is another problem which causes serious defects on the structure or service installation system. Damage on the building while giving service can be rectified by proper maintenance. Neglect and poor quality maintenance are major influences on the incidence of important defects. So to reduce occurrence of defects that lead to failure, it should be a correct use of building and properly managed maintenance activities.

In addition, Rhodes & Smallwood (2012) stated that, the methods of defect detection include observation, inspection, checking work and test samples. The following are some warning signs of possible defects in houses.

- **Deep cracks in the foundation or basement walls:** This may be a sign that the foundation was laid on a poorly compacted base or poorly graded soil.
- **Sagging floors or leaning walls:** A shifting foundation or structural problems (with support beams) could be the problem.
- **Windows and doors that never sit well in frames or close properly:** This problem could be due to beams and joists not being correctly sized or assembled.

**Cracks in interior walls:** Wide cracks could signal a foundation problem. Generally, fine cracks are cosmetic due to normal ageing. Ahzahar *et. al.*, (2011) state that most structural defects which resulting in cracks are common types of building defects. A case study undertaken by Rhodes University's Public Service Accountability Monitor (PSAM) also identified that different kinds of cracks were a

common structural quality defect in the houses within the Ngqushwa Local Municipality. A study undertaken by Fauzi, Yusof & Abidin (2011) in Malaysia also identified cracking of walls and floors as the most common type of defect in the houses.

- **Water damage:** Warning signs include mould, rot, paint peeling, staining, corrosion, swelling or discoloration of interior walls. Possible causes: improperly installed roofing, no waterproof barrier or done incorrectly, lack of a drainage space behind a brick wall, poorly installed windows and doors. Although a study by Rhodes & Smallwood (2012) identified that cracking is the most common type of defect, they also state that dampness- related types of defects dominate the industry (Ahzahar *et al.*, 2011).

#### **2.4 Classification of Building Defects**

Georgia et al (2019) stated that Building defects are always under the spotlight and the grave concern of the construction industry. Different buildings or structures produce different types of defects and require numerous levels and types of quality, which rely on the building functions, the construction or maintenance systems and also materials adopted. Generally, defects can be classified as major defect or minor defect.

**A. Major defect:** It is considered as those which cause the building to become unsafe, unsuitable for living in and not suitable to be used for the purposes for which the building was designed.

**B. Minor defect:** It is considered as those originate from poor workmanship or deficient materials used in the construction of the building, but do not cause the building to become unsafe, unsuitable for living in and not suitable to be used for the

purposes for which the building was designed.

## **2.5 Types of Building Defects**

According to Abdul Rahman *et al.*, (2016), describes defects in construction include either or a combination of the following; defects in structure, giving rise to cracks or collapse; defects or faults in electrical and plumbing installations; inadequacy of drains for proper disposal; Foundation should be made from material that will not fail and lost its stability in the presence of ground or surface water. When the building or property is designed, there should be little or no cracking in the foundation and of course zero water leaks.

Besides that, it is necessary to determine the total load to be supported. Foundations will be carrying out both the dead and live load and will transfer the load to the soil. Moreover, the function of the foundation is to avoid building from sinking due erosion or movement and also to stabilize the building. If there is presence of difficulty in the foundation, it will affect all of the building structure.

Some of the effects of foundation problem are building collapsing, crack on the floor and the wall, the wall leading and many others. Another unstable factor is the movement of the soil because of presents of the water flow. Besides that, the faulty design of the foundation also will cause it to overload. Apart from that, the using of material for the foundation is not being followed as the standard and requirement being agreed (David, 2018).

### **2.5.1 Deterioration of Roof Covering**

Roof as usually exposed to different conditions, particularly to the extremes of temperature degree and change, solar radiation, and wind action. Roofing system

contains many components, such as framing, plywood decking, felt underlayment, sheet metal flashing and other exterior roofing material. Roofs have special risk due to the design of the building itself, such as services passing through the roof covering, and internal gutters. The consequence small defective of roof will may be greater effect of similar defect in a wall or other element (Cheun, 2018).

Roof defects are divided into structural faults and defects in waterproofing material. The majority of roof defects that occurs are distortion of either the roof or off the wall at roof level. Normally, structural defects can be identified from the visual inspection. For the defect of waterproofing material, it will provide the building to be durable under a wide range of exposure condition.

Construction defects in roof system can cause damage to personal property in a home or building, and also to the interior framing members, ceiling, drywall, and paint by allowing water into the building. Common roof system construction defects break roof tiles, damaged framing, exposed damage felt, improper flashing, raised shadow board and loose tiles. A faulty installation is grammatically increasing the likelihood of problems and reduces a roof system's life expectancy (David, 2018).

### **2.5.2 Internal Staining, mould growth and fungal on external wall**

If there is a water intrusion, the chances of mould growth are high. The terms fungi and mould are often used interchangeably, but mould is actually a type of fungi. Concerning about indoor exposure to mould has increased along with public awareness that exposure to mould can cause a variety of adverse health effects.

There are many thousands of species of mould and most, if not all of the mold found indoors comes from outdoor sources. It seems likely to grow and become bigger threat only when there is water damage, high humidity, or dampness. The presence

of mold on a wall of a house can affect occupant's health. Once discovered, mold infestation should be remedied immediately in an effort to minimize the possibility of health issues (Roger, 2015).

### **2.5.3 Dampness**

In general, damp is defined as unwanted water or moisture and its existence in the building is one of the most damaging failures that can occur. It can cause damage in brickwork by saturating it, decay and break-up mortar joints, rot timber structures, make iron and steel corrosion and damage to building equipment.

It can be a serious matter, particularly in the building located near water sources. Somehow, the water can enter the building bit by bit through different routes resulting in dampness. Furthermore, prevailing wet wind and rain will due to water penetrations that occur through the walls.

Dampness also occurs when water penetrates through capillaries or cracks between mortar joints and bricks or blocks before building up trap moisture behind hard renders. Moreover, the contribution of dampness is due to the existence of gravity. The other factor such as leaking gutters or down pipes, defective drains, burst plumbing, and condensation due to inadequate ventilation also can be the factors yielding (Roger, 2015).

### **2.5.4 Peeling Paint**

Peeling paint usually occurs on building facades, mainly on plastered walls, columns and other areas that are exposed to excessive rain and dampness. Some buildings that are located near the sea may face a much higher risk once the signs of peeling paint are visible on the exterior walls. The majority of peeling paint problems occurs

on surfaces exposed to the rain, sun, and the varying degree of temperature. Walls that have involved can be an unsightly mess in a home or building. It may result in embarrassment and frustration to the homeowner. The amount of the constant wind, rain and sun received can easily turn the surfaces of the paint to become chalky and wrinkled or blistered. This problem can become worse if the paint used during construction is low quality and mixed with excessive amount of water (Ghafar, 2014).

### **2.5.5 Leakage**

Leaking is water that seeps out from behind walls, under concrete slabs and asphalts, basements, landscaping, water intrusion in roofs, irrigation systems, and radiant heat system. Leaking mostly happened due to improper installation of piping system that can cause dampness and mold growth, water penetration through external wall defects such as cracks, joints, honeycombs, spelling, weak points, holes, punctures, leftovers of debris, and movement of external wall components, water penetration through defective external wall finishes such as loosened mosaic tiles, cracked ceramic tiles and paint surface; through poor cladding or curtain walls constructions; or weaknesses in water-resisting components, Water leakage through party walls between units of pre-fabricated elements, or between buildings (Rojer, 2015).

### **2.5.6 Defects in doors, windows and external appendages**

Windows and doors are perhaps the most vulnerable building element in external building envelopes, and the need for some windows to be openable further aggravates the problem. Glass panels should always be replaced once cracks occur. Common defects in traditional steel windows usually arise from rusty frames, and deterioration or loss of putty or sealant to hold the glass panels.

Aluminum doors and windows have been widely used in new developments and as replacement of steel windows in existing buildings, but recent incidents of their failure have aroused safety concerns. The aluminum window system involves the assembly of a certain number of components by rivets, screws, hinges and fixing anchors. These accessories, which are prone to failure, require regular servicing and maintenance to prevent failure (Ghafar, 2014).

The friction slide hinges are delicate parts of the window which demand close attention to avoid accumulation of dirt that obstruct the sliding motion and mild lubrication to reduce friction of the moving parts. Without the required servicing and maintenance, hinges may become too tight to operate, rivets may loosen up and screws may be corroded that shorten their lifespan. When excessive forces are applied to operate such windows or when they are subject to wind load, distortion of the window sashes or even the frame may result, causing fatal or serious injuries to the public.

External appendages are usually cantilevered structures which include eaves, moldings, architectural projecting features, air-conditioning hoods, canopies and balconies, drying racks, projecting panels and claddings. Although the structural designs of these elements have already catered for their cantilevered performance, lack of maintenance and repair of combat, natural weathering would attract development of defects, unduly shorten their lifespan and eventually result in collapse.

Common defects that have seen on doors, windows and external appendages are: Cracking at junctions, Bulging (gaps occurring between finishes and paint, wall) or peeling-off of finishes, spalling of concrete or uncovering of steel, reinforced rusting

of metal parts, damage by fungus or vegetation growth, water seepage through the features, corrosion or loosening of attachments (Roger, 2015).

### **2.5.7 Insect or Termite Attacks**

Termites are small, pale to brownish black in color, insect that capable of feeding on mostly anything including timber. The timber is easily deteriorated if exposed to water penetration, high moisture content and loading beyond its capacity as this greedy and colony-living insect is easily attracted to it. Insect or termite attacks pose a threat to damp and digested timber found in wall plates, the feet of rafter, bearing ends of beams and trusses. Affected timber can be treated by pressure-spraying with insecticide or fumigant insecticidal process (Ghafar, 2014).

Subterranean termites or underground termites are the most destructive insect pests of wood. The activity of them is often not readily noticed because it is hidden behind wallboards, sliding or wood trim. Basically, foraging of termites by dead trees and brush provides a natural food source. When natural vegetation is cleared and houses are built, termites often switch to feeding on wooden structures. Next, they will continue to enter the building through wood that is direct contact with the soil and by building shelter tubes over or through the cracks found in the foundation. Infestation of termites can do damage to any cellulose-based material in direct contact with the soil (Roger, 2015).

Most of timbers that are commonly affected by termites are plywood, Meranti, and Selangan beta and also ironwood. Any building that touches the soil and from tree branches will be attacked by termites. Besides that, dead wood, tree stumps and nearness to forest areas also increase the likelihood of the attack. To avoid this, the forest must be cleared for building, and the dead wood should be removed and are

not left to rot under the residence. On top of that, the beams also should be supported on old stumps (Lipa, 2013).

Termites will survive as long as the situation or environments meet their chance of survival. They can spread easily in a blink of an eye into a larger area and build their nest there, in the building or property. The requirements in their chance of surviving are; moisture, source of food, dark, and low light Intensity, minimal flow of air.

### **2.5.8 Defective Plaster Rendering**

Plaster or render is like mortar coating over the block work. The coating on the inside walls called plaster, then the coating outside the walls called reinder. Plaster and render is totaling different. The render is generally richer and mostly in cement than the plaster due to weather resistant.

The both of plaster and renders have different function. The plaster insides the walls to make the walls smooth, easy to clean, avoid from insect, and for better appearance. Apart from that, the plasters act as a protection against fire. The other functions are breathable for walls, abrasion resistant, and suitable for decorating or covering with coating, wallpaper and tiles. For the renders, is provided to protect them from the influences of the weather.

Mostly the defective plaster rendering occurs on the external walls, column and ceiling. Defective rendering is normally caused by biological attacks arising from penetrating rain, evaporation, condensation, air pollution, dehydration and thermal stress. The mould or harmful growth, insect, animals, and traffic vibration also will contribution causes of defective plaster rendering. Prior to being decomposed and broken apart, rendering may crack due to either shrinkage or movement in the substrate. Ghafar (2014) classifies types of defective plaster rendering into four.

**Cracking in Plastering:** This is because of breaking away the section of the plaster. Penetration of rain to the external surface of structural, have allowed admittance of rain to the back of the intact plaster coat. So, any weakness in the bond between the plaster and background or between renders coats will make the further defect.

**i. Holes in Plaster wall:** Holes usually occur because of, user or human made such as hanging family picture, shelves or other decorative item to the wall. It is easy to be filled in with a tad of sparkling compound.

**ii. Plaster falling off from the ceiling:** Often the vibration of people going up and down by the stair for many years is cause to plaster falling off from the ceiling. The vibration will travel through the plaster and cause hairline cracks between the wall and plaster.

**iii. Shrinkage cracking:** When strong mixes of render are used on weak or bad prepared background have due to shrinkage cracking. If the crack only in the topcoat, it caused the excessive cement in the finish coat or excessive thickness or if the renders are too wet.

### **2.5.9 Defects in Building Services Installation**

Services installations have a relatively shorter life span than the building structure. Defects in the mechanical components usually lead to failure requiring repair or servicing. It is therefore necessary to have a planned schedule for foreseeable servicing and replacement of components. Avoid exhausting the designed lifespan of such components can prevent sudden breakdown of services that causes undesirable or even disastrous consequences. Common defects in building services installations are water supply (such as blockage or leakage of components of the pipes or valves, rusty pipes, pump failure, breakage of supply pipe, defective water tanks, defective

pipe joints or valves, leakage in the system after water meters), fire services (such as alarm wiring defect, short circuit, inadequate protection or poor management, inadequate maintenance), electricity supply (of fuse or circuit breaker, earth leakage, overloading, uneven distribution of phase set.), lift and escalator, air conditioning / heating (such as poor efficiency, leakage of refrigerant dust and dirt of heat, loosen parts, blowers or propellers breakage, insulation failure).

## **2.6 Causes of Building Defects**

According to Rhodes and Smallwood (2012), the causes of defects can be related to design, construction, procurement and prevailing environmental conditions. They also describe the origin of defects as being inadequate management and technical skills. Weldon (2018) states that building defects or failures may arise due to a variety of factors, including poor design, failure of the material, poor workmanship, and lack of maintenance. Around 32 out of 55 federal building construction related defect were attributed by poor workmanship. Defective material takes the next role by causing almost 20 percent of construction defects. Design error cause just more than 15 percent of construction defects and the remaining defects were caused by poor subsurface investigation and improper usage of building services (Bedru, 2015).

Manning (2015) mentions that all types of defects their causes can be grouped into the following seven major categories.

### **2.6.1 Design Defects**

Buildings and systems designed by engineers do not always work as specified; this can result in a defect. Typical design deficiencies relate to buildings outside the specified code.

A common design error is often made, usually in an effort to save initial

construction costs. Project cost plays an important role in designing buildings. Reducing the size of a common design error is often made, usually in an effort to save initial construction costs.

Project cost plays an important role in designing buildings. Reducing the size of columns, the size of reinforcement bars and foundations are the most common design error in construction. This situation will lead to uncertainty situation in the future where the structure cannot withstand the load and finally fails. Sometimes faulty design is also a result of misjudgment, leading to assumptions or decisions that are not consistent with the actual behavior of the structure.

### **2.6.2 Material Defects**

The use of inferior building materials can cause significant problems such as windows that leak or fail to perform even when properly installed. Materials may easily be damaged during transportation, loading and unloading, inappropriate condition of storage on site and placing in position even though the materials may be flawless upon leaving the factory. The defects can be prevented with by taking greater care during all the stages during the construction project, providing appropriate training to all the workers and staffs, and ensuring closer supervision.

### **2.6.3 Poor Workmanship**

Error in workmanship can result in long lists of defects, e.g. plumbing leaks. According to Gibbon (2017), poor workmanship in housing construction, poor management and control of building contractors has contributed to the housing problem. The installation of the roof will need number of skilled workers. If the roof is not installed properly, it is yielded to roof defect such as roof leakage and sagging. The causes of roof defect because the worker may be not having a license, or certificate apart from having a low level of experience. Poor workmanship

often leads to delays in projects. Lubisi & Rampedi (2019) contend that the primary causes of delays are related to the perception that emerging subcontractors with capacity challenges were always appointed to execute projects and poor performance by the contractor.

#### **2.6.4 Subsurface Deficiencies**

Many houses are built on hills or other areas where it is difficult to provide a stable foundation. Lack of a solid foundation may result in cracked foundations or floor slabs as well as other damage to the building. Subsurface conditions that are not properly compacted or prepared may cause problems; these include improper settling to the ground or the shifting of a structure.

#### **2.6.5 User Activities**

Defects may be caused by unintended misuse due to lack of knowledge of the correct method of usage or intentional acts of vandalism. This problem can be solved by providing more information such as the degree of severity of use and condition of use to the designer so that a better output can be yield. Besides, some defects may be correlated to the users' financial conditions and also social attitudes. For instance, condensation is affected by the amount of money spent on heating and ventilating, and occupancy pattern.

#### **2.6.6 Maintenance**

Building maintenance prepared through an accurate program of repeated maintenance plays a major role in preventing building defects. Buildings that neglect building maintenance may fall into several defects which may lead to structural failures. Any inspections carried out by either architects or surveyors should include checking for any signs of abnormal deterioration, cleaning out gutters of leaves or

harmful growth, checking lighting conductors, cleaning out all voids and spaces; and changing tap washers. To secure the general structural stability and life of a building, it is important to regularly inspect not only the main structural elements, including foundations, walls and roofs; but other common building problems. It is important that buildings continue to be properly maintained to ensure that they can function as efficiently and effectively as possible in supporting the delivery of a wide range of services. At the same time, the deterioration of buildings due to the lack of maintenance could lead to future financial burdens, pose legal and other industrial relations issues and affect the delivery of services. Therefore, the maintenance of buildings is critical to the proper management of physical assets and the overall management of capital to achieve agency outputs and institutional outcomes.

#### **2.6.7 Climatic Conditions**

It is important to consider the climatic conditions of construction area and the effect to building materials. This implies that buildings in the country tend to weather rapidly, particularly in respect to external building materials which are exposed to external causes such as rain, wind, solar radiation including ultra-violet light; and atmospheric pollution.

Fungal stains, harmful growth, peeling paint, erosion of mortar joints and defective plastered rendering are a few examples associated with this factor.

## CHAPTER THREE

### RESEARCH METHODOLOGY

#### 3.1 Introduction

The purpose of research method is to discuss method that was adopted in a research project to provide data in order to investigate the research question in the study. This chapter provides information on the method that was adopted and how the study will be carried out. It is divided into a number of sections which include research design, sample size, simple frame, sample technique, data collection instruments, design and content of questionnaire, administration of questionnaires, data collection and method of data presentation and analysis.

#### 3.2 Research Design

The research design refers to the structured plan and strategies of investigation concerned for the purpose of obtaining response to the research question and controlling variance that may arise (Brandom, 2000). A research design is a careful planning of a successful investigation for conducting and analyzing data to enhance the validity of the study. It is the blue print for data collection and presentation. The survey research design was adopted for the study. Well-structured or close-ended questionnaires will be administered to the target respondents who are professionals in the construction industry within Edo state.

#### 3.3 Research Population

The population is the study's target population that it intends to study or treat (Majid *et al.*, 2018). It is the set of all elements in interest. The population of this study are members of the construction industry which include, Architects, Quantity surveyors, Builders, Contractors and Engineers in Edo state

### 3.4 Sampling Frame

The accuracy of a sample is assessed by how well it represents the population of participant from which the sample was drawn. The population for this study are Architects, Quantity surveyors, Builders, Contractors and Engineers in the study area. Table 3.1 shows the sampling frame of the respondent

**Table 3.1 Sample frame for Respondents**

S/N	Respondents	Population
A.	Architects	26
B.	Quantity surveyors	31
C.	Engineers	33
D.	Builders	15
E.	Contractor	30
F.	Project Managers	10
	Total	145

*Source:* Field Survey (2022)

### 3.5 Sample Size

There are several approaches to determining the sample size. For the purpose of this study, applying formulae to calculate a sample size was adopted. There are several formulas for Determining sample size, for population that are large; Yamare (1967) developed an equation to Yield a representative sample for the population.

$$N = X$$

$$1 + N(0.5)^2$$

Where n = sample size

x = Observation unit

N = population size

E = sample error or level of significance

Where N is the population size and n in sample size, e is 0.05. therefore, for a 145 population size

N= 106 respondents

$$1 + 145(0.05)$$

The breakdown for the respondents is show in table 3.2 below

**Table 3.2: Sampling size**

S/N	Respondents	Population
G.	Architects	22
H.	Quantity surveyors	18
I.	Engineers	22
J.	Builders	15
K.	Contractor	15
L.	Project Managers	14
	Total	106

*Source:* Field Survey (2022)

### **3.6 Sampling Techniques**

Odeyinka (2015) stated that the process of sampling or selection of population from which the characteristic of the longer population can be inferred has long been accepted as a legitimate and efficient method of research. The main object of sampling is to provide a practical means of achieving data collection and processing. There are two main strategies of sampling: probability sampling method and non-probability sampling. For the purpose of this study, non-probability sampling method was employed in the selection based on the need of getting adequate information. Judgment sampling was used for survey aspect because respondents was selected by judgment based on their profession and understanding of the subject matter.

### **3.7 Data Collection Instrument**

Research instrument are mainly used for data collection which provide the information for answering the research questions earlier drawn for the study. Research instrument also refers to the measuring device such as test, questionnaires, scales, checklist, inventories, observation and interview. For the purpose of this research, well-structured questionnaire was administered for the collection of relevant information in order to easily carryout detailed data analysis. The

questionnaire is a device for getting answer to questions by using a form which the respondents fill by him or herself.

### 3.8 Method of Data Collection

Primary and secondary data collected, through the use of Questionnaires which was administered personally by the researcher to the respondent(s) as form of primary data collection method. This was done directly by the researcher i.e. by face to face or by electronic means such as phone calls, text, mail etc. The secondary data collection method includes information from books, journals, internet source and related seminar papers.

### 3.9 Method of Data Presentation and Analysis

Tables will be used in this study for data presentation. Percentiles, Mean item score and ranking as well as Relative importance index will be used for data analysis.

**Tables 3.8.1**

#### Research objectives and methods of analysis.

S/N	Objectives	Research Instrument	Statistical tools
1.	To identify the major causes of building defects in the Nigerian construction industry	Survey	Mean Item Score
2.	What are the effects of building defects on the Nigerian construction sector?	Survey Survey	Relative Importance Index
3.	To evaluate the measures that could be adopted in mitigating the effects of building defects in the Nigeria building industry		Mean Item Score

Table 3.2 above shows the statistical tools that are applied for the analysis of the objectives of this research work.

### 3.10 Percentage

Percentages are any given ratio multiplied by 100. It helps in rating the number of factors according to degree of occurrence attached (Olabisi, 2014). A percentage describes how many parts are there out of one hundred parts of a particular item.

Mathematically  $P (\%) = \frac{n}{N} \times 100$

Where P= Percentage

N= Value of item

N= total value of the item

#### 3.10.1 Mean Item Score

Means score can be defined as a central value such that both the positive and negative deviation from it ultimately cancel themselves out (Olabisi, 2014)

Mathematically  $\bar{X} = \frac{\sum xi}{N}$

Where f = Frequency of respondent's choice of the scale.

X= points on the Likert's scale

$\sum$ = Summation of all the scores

N= Total Number of respondents.

#### 3.10.2 Relative Importance Index (RII)

The relative importance index (RII) is the mean for a factor which gives it weight in the perception of respondents. The factors with the highest weight has RII=1 while the next factor with lower weight has RII= 2 and so on. This is calculated as follows (Rana, 2017).

Relative index = R II =  $\frac{I (W n) \times 100 \%}{A \times N}$

Where,

W = Constant expressing the weighting given to each response.

A = Highest weighting

$n$  = Frequency of responses

$N$  = Total number in the responses

**CHAPTER FOUR**  
**DATA ANALYSIS AND DISCUSSION**

**4.1 Introduction**

This chapter presents the result and analysis of the data obtained for the purpose of the study in accordance with the objectives for the study. A total of 145 questionnaires were administered and 80 were recovered successfully and found to be suitable for analysis

The findings were analyzed and presented in form of frequency tables, numerical values and percentages generated through the use of relevant statistical tools

**4.2 Demographic information of the respondents**

**Table 4.1: Profession of Respondent**

<b>Profesion</b>	<b>Frequency</b>	<b>% of Respondent</b>
Architects	30	37.5
Quantity Surveyors	20	25
Builders	15	18.75
Engineers	15	18.75
<b>Total</b>	<b>80</b>	<b>100</b>

From Table 4.1 above, the result shows that among 145 Questionnaire that was distributed and the 80 questionnaires that were successfully returned, 30 amounting to (37.5%) of the respondents are Architects, 20 amounting to (25%), of the respondents are Quantity Surveyors 15 amounting to (18.75%) of the respondents are Engineers while 15 amounting to (18.75%) are builders.

**Table 4.3: Academic Qualification of Respondents**

<b>Academic Qualification</b>	<b>Frequency</b>	<b>% of Respondent</b>
OND	20	25
HND	30	37.5
BSC/B.TECH	15	18.75
MSC	10	12.5
PHD	5	6.25
<b>Total</b>	<b>80</b>	<b>100</b>

From Table 4.3, 20 amounting to (25%) of the respondents are OND, 30 amounting to (37.5%), of the respondent are HND, 15 amounting to (18.75%) of the respondents

are BSC/B.TECH holders, 10 amounting to (12.5%) of the respondents are M.sc holders, while 5 amounting to (6.25%) are PHD holders

**Table 4.3: Professional Qualifications of Respondents**

<b>Professional Membership</b>	<b>Frequency</b>	<b>% of Respondent</b>
Probationer Members	40	50
Corporate Members	30	37.5
Fellows	10	12.5
Others	-	-
<b>Total</b>	<b>80</b>	<b>100</b>

From Table 4.4, 40 amounting to (50%) of the respondents are Probationer Members, 30 amounting to (37.5%), of the respondents are Corporate Members, while 10 amounting to (12.5%) of the respondents are Fellows.

**Table 4.4: Organization of Respondents**

<b>Organization of Respondent</b>	<b>Frequency</b>	<b>% of Respondent</b>
Government	50	62.5
Contractor	20	25
Consulting	10	12.5
Others	-	-
<b>Total</b>	<b>80</b>	<b>100</b>

From Table 4.5, 50 amounting to (62.5%) of the respondents are Government, 20 amounting to (25%), of the respondents are Contractor, 10 amounting to (12.5%) of the respondents are Consulting.

**Table 4.5: Years of experience of Respondents**

<b>Years of experience</b>	<b>Frequency</b>	<b>% of Respondent</b>
1-5	20	25
6-10	10	12.5
11-15	40	50
16-20	5	6.25
Above 20	5	6.25
<b>Total</b>	<b>80</b>	<b>100</b>

From Table 4.5, 20 amounting to (25%) of the respondents are 1-5 years, 10 amounting to (12.5%), of the respondents are 6-10 years, 40 amounting to (50%) are the respondents of 11- 15, 5 amounting to (6.25%) of the respondents are 16-20, 5 amounting to (6.25%) of the respondents have more than 20 years of experience in construction and above.

**Table 4.6: Number of projects handled**

<b>Years of experience</b>	<b>Frequency</b>	<b>% of Respondent</b>
1-5	20	25
6-10	10	12.5
11-15	40	50
16-20	5	6.25
Above 20	5	6.25
<b>Total</b>	<b>80</b>	<b>100</b>

From Table 4.6, 20 amounting to (25%) of the respondents are 1-5 years, 10 amounting to (12.5%), of the respondents of 6-10 years, 40 amounting to (50%) of the respondents of 11-15, 5 amounting to (6.25) of the respondents of 16-20, 5 amounting to (6.25) of the respondents 20 and above

**Table 4.7 Identified causes of building defects in the Nigerian construction industry**

<b>Identified causes of defects</b>	<b>RII</b>	<b>Ranking</b>
Use of substandard construction materials	4.62	1
Poor standard of workmanship	4.25	2
Inadequate funding of project	4.12	3
Unrealistic contract duration	3.87	4
Engagement of quacks in construction execution	3.62	5
Non-involvement of qualified construction professionals	3.50	6
Absence of specialist technology	3.50	7
Lack of maintenance culture	3.12	8
Structural inability of buildings	3.12	9
Lack of skilled manpower	2.75	10
Fluctuations in the construction market	2.62	11
Rising cost of building materials	2.50	12
Lack of expertise by the consultant	2.50	13
Complexity of project	2.50	14
Lack of previous experience of contractor	2.50	15
Inappropriate specification of materials	2.32	16
Non-usage of construction plant and equipment	2.25	17
Nature and type of project	2.25	18
Poor quality of the final construction product	2.12	19

Type of procurement method adopted for the project	2.00	20
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**Source: Field Survey (2022)**

**Table 4.8:** above reveal the causes of building defects in the Nigerian construction industry. Use of substandard construction materials with a mean score of 4.62 with the highest factor and closely followed by Poor standard of workmanship and Inadequate funding of project, the least of the respondents include Poor quality of the final construction product with a mean score of 2.12 and follow by Type of procurement method adopted for the project with a mean score of 2.00 respectively.

**Table 4.9 Effects of building defects in the Nigerian construction sector**

<b>Identified Effects</b>	<b>Mean score</b>	<b>Ranking</b>
Inability of building to perform their primary function	4.25	1
Absence of client satisfaction at the end of project execution	3.87	2
Possibility of building collapse	3.75	3
Lack of sustainable duration on the part of the project	3.62	4
Structured failure of buildings	3.50	5
Lack of quality assurance for completed projects	3.12	6
Reduced benefits for End-User	3.12	7
Increase in the frequency of maintenance requirement	2.62	8
Cost implication of maintenance needs	2.50	9
Wastage of investment of construction resources	2.50	10
Functional failure of building facilities	2.32	11
Discomfort for the owner-occupier	2.25	12
Enhanced depreciation of building structure	2.25	13
Compromised integrity of the building structure	2.12	14
Absence of safety for the occupant	2.00	15

**Source: Field Survey (2022)**

**Table 4.9:** above reveals the effect of building defect on the Nigerian construction sector. Inability of building to perform their primary function with a mean score of 4.25, closely followed by Absence of client satisfaction at the end of project execution with a mean score of 3.87 and Possibility of building collapse with a mean score of 2.12, the least of the respondents include Compromised integrity of the building structure with a mean score of 2.12 and closely follow by Absence of safety for the occupant with a mean score of 2.00 respectively.

**Table 4.10 Identified Measures that could be adopted to mitigate the effect of building defects in the Nigerian construction industry**

<b>Identified Measures</b>	<b>Mean score</b>	<b>Ranking</b>
Use of standardized materials for construction	3.87	1
Enhanced standard of workmanship	3.62	2
Adequate project financing by client	3.50	3
Feasible and realistic contract duration	3.50	4
non-engagement of quack in construction	3.12	5
Involvement of qualified construction professionals	3.12	6
Use of adequate specialist technology	2.75	7
Adoption of appropriate maintenance culture for Complete project	2.62	8
Usage of skilled manpower for project execution	2.50	9
Construction expertise on the part of consultant	2.50	10
Appropriate specification for building plant equipment	2.32	11
Use of adequate construction plant and equipment	2.25	12
Enhanced quality of the final construction product	2.25	13
Adequate costing without compromising quality	2.12	14
Adoption of appropriate procurement method	2.00	15

**Table 4.10:** above reveals the measure that could be adopted to mitigate the effect of building defects in the Nigerian construction industry. The Use of standardized materials for construction with a mean score of 3.87 and closely follow by Enhanced standard of workmanship with a mean score of 3.62 and Enhanced standard of workmanship with a mean score of 3.50. The least of the respondents include Adequate costing without compromising quality with a mean score of 2.12 and closely follow by Adoption of appropriate procurement method with a mean score of 2.00 respectively.

#### **4.2.1 Summary of Findings**

This study characterized with Profession of Respondent 145 Questionnaire that was distributed the 80 questionnaires that were successfully returned, Use of substandard construction materials with a mean score of 4.62 with the highest factor and closely follow by Poor standard of workmanship and Inadequate funding of project, the least of the respondents include Poor quality of the final construction product with a mean score of 2.12 and closely follow by Type of procurement method adopted for the project with a mean score of 2.00 respectively. Effect of building defect in the Nigerian construction sector Inability of building to perform their primary function with a mean score of 4.25, closely follow by Absence of client satisfaction at the end of project execution with a mean score of 3.87 and Possibility of building collapse with a mean score of 2.12, the least of the respondents include Compromised integrity of the building structure with a mean score of 2.12 and closely follow by Absence of safety for the occupant with a mean score of 2.00 respectively.

Measure that could be adopted to mitigate the effect of building defects in the Nigerian construction industry. The Use of standardized materials for construction with a mean score of 3.87 and closely follow by Enhanced standard of workmanship with a mean score of 3.62 and Enhanced standard of workmanship with a mean score of 3.50. The least of the respondents include Adequate costing

without compromising quality with a mean score of 2.12 and closely follow by Adoption of appropriate procurement method with a mean score of 2.00 respectively. Method of improving the application of building defects in construction industry Better time utilization with a mean score of 3.75 closely follow by better work organization with a mean score of 3.62 and defined goal and objective with a mean score of 3.12. The least of the respondents include Reduce cost and time overruns with a mean score of 2.32 and more project success and closely follow by Enhance better communication with a mean score of 2.25

## **CHAPTER FIVE**

### **CONCLUSION AND RECOMMENDATION**

#### **5.1 Introduction**

This is the final chapter in this research, which contain recommendation and conclusions that hope will contribute to solving the problem of effects of building defects on the performance of the Nigerian construction industry.

#### **5.2 Conclusion**

This study identify and assessed the assessment of the causes and effects of building defect on the performance of the Nigerian construction industry it has also identified and assessed the effects of building defects on the Nigerian construction sector, identified measure that could be adopted to mitigate the effect of building defect in the Nigerian construction industry.

In accordance and in line with the analysis result drawn up from the respondent responses of the questionnaires regarding the effects of building defects on the performance of the Nigerian construction industry.

The research also summarizes some causes of delay in building defects such as use of substandard construction materials, poor standard of workmanship, inadequate funding of projects, unrealistic contract duration, Engagement of quacks in construction professionals, Absence of specialist technology, lack of maintenance culture, structural inability buildings, lack of skilled manpower, fluctuations in the construction market, rising cost building materials, lack of expertise by the consultants, complexity of the project, lack of previous experience of contractor, inappropriate specification of materials, non-usage of construction plants and equipment, nature and type of project, poor quality of the final construction products and type of procurement method adopted for the project. The result further reveals effects of building defects, Inability of building to perform their primary function, Absence of client satisfaction at the end of project execution, Possibility of

building collapse, Lack of sustainable duration on the part of the project, Structured failure of buildings, Lack of quality assurance for completed projects, Reduced benefits for End-User, Increase in the frequency of maintenance requirement, Cost implication of maintenance needs, Wastage of investment of construction resources, Functional failure of building facilities, Discomfort for the owner-occupier, Enhanced depreciation of building structure, Compromised integrity of the building structure and Absence of safety for the occupant. Furthermore the study revealed measure that could be adopted as the Use of standardized materials for construction, Enhanced standard of workmanship, Adequate project financing by client, Feasible and realistic contract duration, Structured failure of buildings, non-engagement of quack in construction, Involvement of qualified construction professionals, Use of adequate specialist technology, Adoption of appropriate maintenance culture for Complete project, Usage of skilled manpower for project execution, Construction expertise on the part of consultant, Appropriate specification for building plant equipment, Use of adequate construction plant and equipment, Enhanced quality of the final construction product, Adequate costing without compromising quality, Adoption of appropriate procurement method and in addition the study further reveals the method of improving the application of building in defects as better work organization, Defined goal and objective, Better time utilization, knowing work progress, Reduce cost and time overruns and more project success, Enhance better communication

### **5.3 Recommendations**

- i. Improvements on all project management phases need to be done by the client including amending the existing contractual document like specification and guidelines with the nature of building projects and current problems seen regarding building defects.
- ii. Different capacity building programs like trainings and workshops has to be

designed on regular basis for micro scale enterprises, semi-skilled and unskilled employees of contractors.

- iii. Right from the planning stage to the completion of a project, the client is recommended to have continual program evaluation for timely corrective measure throughout the project duration.
- iv. Construction supervisors on the site should be aware that they have shared on improving the causes of construction defects and many complaints arise when the owners hand over the houses. So, they should follow strict supervision during construction.
- v. Since the incidence of building defects affects all the parties in the construction shall have continuous communication in order to improve the problem.

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## **APPENDIX**

Department of Quantity Surveying,  
School of Environmental Studies  
Auchi Polytechnic,  
P.M.B 13,  
Auchi.  
Edo State

Dear Respondent,

### **REQUEST FOR COMPLETUION OF QUESTIONNAIRE**

I am a final year student of the above named institution and department currently carrying out a research work titled **“ASSESSMENT OF THE CAUSES AND EFFECT OF BUILDING DEFECTS ON THE PERFORMANCE OF THE NIGERIAN CONTRUCTION INDUSTRY”**.

This topic was chosen with the view of enhancing the effect of project management techniques on construction project performance in Nigeria. I wish to humbly seek for your response to the attached questionnaire as the information supplied will be treated and strictly used for academic purpose.

Thanks in anticipation.

Yours Faithfully

Obichukwu Favour

## SECTION A

Background information of the respondents

Instruction: Please tick and complete the questionnaire where necessary

1. Professions of respondent

(a) Architect  (b) Quantity Surveyor  (c) Builder  (d) Engineer

2. Educational qualification of respondents

(a) OND  (b) HND  (c) B.SC / B.TECH  (d) MSC  (e) PHD

3. Professional qualification of respondents

(a) Probation Members  Corporate Members  Fellows  the Others

4. Type of organization of respondents

(a) Government  (b) Contracting  (c) Consulting  the Others

5. Years of experience of respondents

(a) 1-5 yrs  (b) 6-10 yrs  (c) 11-15 yrs  (d) 16-20 yrs  (e) above  
20yrs

6. Number of projects handled by respondents

(a) 1-5  (b) 6-10  (c) 11-15  (d) 16-20  (e) Above 20

## SECTION B

(1)

The following have been identified as some of the major causes of building defects in the Nigerian construction industry. Kindly rate the identified factors in the order of severity using the scale below:

5- Very High, 4- High, 3- Moderate, 2- Low 1- Very Low

S/N	IDENTIFIED FACTORS	5	4	3	2	1
1.	Use of substandard construction materials					
2.	Poor standard of workmanship					
3.	Inadequate funding of projects					
4.	Unrealistic contract duration					
5.	Engagement of quacks in construction execution					
6.	Non-involvement of qualified construction professionals					
7.	Absence of specialist technology					
8.	Lack of maintenance culture					
9.	Structural inability of buildings					
10.	Lack of skilled manpower					
11.	Fluctuations in the construction market					
12.	Rising cost of building materials					
13.	Lack of expertise by the consultants					
14.	Complexity of the project					
15.	Lack of previous experience of contractor					
16.	Inappropriate specification of materials					
17.	Non-usage of construction plants and equipment					
18.	Nature and type of project					
19.	Poor quality of the final construction products					
20.	Type of procurement method adopted for the project					

(2)

The following have been identified as the effects of building defects on the Nigerian construction sector. Kindly rate the identified effects according to the level of

significance using the scale below:

5- Very High, 4- High, 3- Moderate, 2- Low 1- Very Low

S/N	IDENTIFIED EFFECTS	5	4	3	2	1
1.	Inability of building to perform their primary functions					
2.	Absence of client satisfaction at the end of project execution					
3.	Possibility of building collapse					
4.	Lack of sustainable durability on the part of the project					
5.	Structured failure of buildings					
6.	Lack of quality assurance for completed projects					
7.	Reduced benefits for End-Users					
8.	Increase in the frequency of maintenance requirements					
9.	Cost implication of maintenance needs					
10.	Wastage of investment of construction resources					
11.	Functional failure of building facilities					
12.	Discomfort for the owner-occupier					
13.	Enhanced Depreciation of building structure					
14.	Compromised integrity of the building structure					
15.	Absence of safety for the occupant					

**(3)**

The following have been identified as the measures that could be adopted to mitigate the effects of building defects in the Nigerian construction industry. Kindly rate the identified measures according to the degree of importance using the scale below:

S/N	IDENTIFIED MEASURES	5	4	3	4	5
1.	Use of standardized materials for construction					
2.	Enhanced standard of workmanship					
3.	Adequate project financing by clients					
4.	Feasible and realistic contract duration					
5.	Non-engagement of quacks in construction					

6.	Involvement of qualified construction professionals					
7.	Use of adequate specialist technology					
8.	Adoption of appropriate maintenance culture for completed projects					
9.	Usage of skilled manpower for project execution					
10.	Construction expertise on the part of consultants					
11.	Appropriate specificatio for building materials and components					
12.	Use of adequate construction plant and equipment					
13.	Enhanced quality of the final construction product					
14.	Adequate costing without compromising quality					
15.	Adoption of appropriate procurement method					

## SECTION

Examine the method of improving the application of building defects in construction industry. Kindly rank them based on the degree of importance using (scale 5-very high, 4-high, 3-moderate, 2-low, 1-very low)

S/N	EXAMINE THE METHOD	5	4	3	4	5
1	Better work organization					
2	Defined goal and objective					
3	Better time utilization					
4	Knowing work progress					
5	Reduce cost and time overruns and more project success					
6	Enhance better communication					