EVALUATION ON THE CAUSES OF BUILDING COLLAPSE IN EDO STATE, NIGERIA

BY

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PLAGIARISM

This work **EVALUATION ON THE CAUSES OF BUILDING COLLAPSE IN EDO STATE, NIGERIA** by OSSAI, Chucks with Matriculation Number ENG2002138 of the Department of Civil Engineering, Faculty of Engineering, University of Benin City, Edo State, Nigeria, has PASSED the PLAGIARISM TEST.

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DEDICATION

This project is dedicated to God and my lovely family for their financial supports and love towards me during thee period of this work.

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ABSTRACT

The age-less interaction between man and his built environment has always had positive and negative impacts on the two. Environmental disaster of varying origin from man-made to natural is one of the most negative effects of the built environment on man. An assessment of the magnitude of these disasters and an evaluation of the existing capacities to prevent, mitigate or prepare for them are necessary tools to provide future safe living for man in his built environment. Building collapse established to be caused by many factors is one of such disasters wielding its great impact of loss of lives and properties on man.This study evaluated the causes of building collapse in Edo State by identifying the major causes of collapse, assessing its effect, and also assessing the roles of government and construction professionals in mitigating the occurrence of building collapse in Edo State.

The method use to carry out this study involves materials harvested from the different building collapse sites, structural analysis of the collapse building and distribution of questionnaires to gather information relevant to the study.

Findings from the study show that building failure and collapse in Edo State arise mainly from a combination of technical weaknesses and human negligence. Poor structural design emerged as a major cause, followed closely by flooding, which weakens foundations, reduces soil stability, and accelerates material deterioration. Low compressive strength of blocks, inadequate supervision, and the use of inexperienced or unqualified personnel also contributed significantly to building failures. Other notable factors include ignorance of construction standards, deliberate avoidance of building regulations, and weak enforcement of quality control measures on construction sites and in the building materials market.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Surprisingly, the rate at which the current ones are failing demands call for immediate attention. Since Nigeria's independence in 1960, the government has attempted valiantly to provide mass housing in a quantitative rather than qualitative manner through extensive budgetary and policy provisions. The number of building collapses strewn over Nigeria is so concerning that it is impossible to predict the impact they would have on the country's construction sector and overall economy. If only these structures had been built appropriately, one could envision what they would have been.

According to statistics, Nigeria particularly Lagos State has turned into the "world's junk- yard" of buildings that have collapsed, with a combined value of billions of naira (Aigbokhan, 2004). That such a large building collapse could occur in a nation endowed with such enormous potential in its construction sector is simply unthinkable. Buildings are "enclosures for spaces designed for specific use, meant to control local climate, distribute services, and evacuate waste," according to Bamidele (2020). Another definition of a building is a structural entity that may transmit weights to the ground in order to secure itself (Opara, 2017). Buildings are therefore structures for human activity, as long as they are safe for the occupant. However, because of their collapse, these same buildings have been causing people to be irritated and upset, either during or after construction.

Collapse as a whole happens when a structure's entire body or a portion of it fails and abruptly gives way; as a result, the structure is unable to fulfil its intended function. An severe form of building failure is building collapse. It indicates a complete or partial collapse of the superstructure (Ameh, 2017). Building failure happens when one or more building components have a flaw that prevents the materials that make up those components from carrying out their intended function, which can ultimately result in the building collapsing. Although structures are supposed to give people shelter and convenience, they are currently acting as a danger trap for these people. According to Oloyede (2010), a building must fulfil a number of fundamental characteristics, including durability, design performance, cost effectiveness, quality, safety, and timely completion. Although it is often anticipated that buildings will be both lovely and useful, many projects are built that fall short of these fundamental standards. This leads to the frequent occurrence of building collapses, some of which result in the deaths of innocent people. No one has been able to determine how each of the identified factors directly contributes to building collapse in Nigeria, despite numerous studies and workshops conducted by various bodies, government agencies, and institutions in the country's major cities to examine the causes of building collapses. According to Oloyede (2010), a number of issues, not only in Nigeria but elsewhere in the world, might lead to building collapse. These factors are mostly based on structural design and quality management. Variability in materials, testing, judgement, contractors, incompetent workers, and unprofessional behaviour are all part of quality management. The purpose of this study was to assess the causes, consequences, and solutions of building collapses in Edo State, Nigeria.

1.2 STATEMENT OF RESEARCH PROBLEM

A flaw, inadequacy, or problem in a building element or component may causes a building to collapse. It might also be the consequence of performance omission. Therefore, the degree of a building's collapse can be linked to how far it deviates from its "as-built" condition, which often represents the acceptable standard in the neighbourhood, locality, state, or nation (Chinwokwu, 2010).

All parties involved the government, private developers, clients and users, construction industry specialists, and local residents are very concerned about Nigeria's ongoing building collapses, which is why this project is of utmost importance. Numerous people have died as a result of this catastrophe's terrible effects in Edo State and throughout the nation. According to records, there were 231 injuries and 426 fatalities in Nigeria as a result of building collapse. In addition to Edo State, other governments, including as Lagos, are also having difficulty addressing the ongoing problem of building collapses. Based on previous engineering study, the majority of them concluded that low-quality materials are to blame for these failures. Workmanship was responsible for 111 fatalities (26%) and 121 injuries (45%), according to the number of casualties already mentioned. This also illustrates how the collapse of buildings in Nigeria is significantly impacted by this particular actor. This study, which uses Edo State as a case study to determine the main causes, effects, and likely corrective measures to building collapse in Nigeria, is therefore extremely important and relevant to all construction workers and the government. It is based on the necessity to address the causes of building collapse in the nation.

1.3 AIMS AND OBJECTIVES OF THE STUDY

The aim of this study is to evaluate the causes of building collapse in Edo State.

The Objectives of the study are to:

1. Identify the major causes of building collapse in the state.

2. Assess the effects of building collapse in the state.

3. Assess the roles of Government and construction professionals in mitigating the occurrence of building collapse in the state.

1.4 SCOPE OF THE STUDY

This study examines five (5) major building collapses in Edo State, including two in Auchi, one in uromi and two in Benin City. For this reason, the study uses the case study technique to identify the reason behind the building collapse in Edo State. Its impact and the government's and construction industry's role in reducing the likelihood of building collapses in Edo State. Samples of the soil from the building collapse were collected and examined. Additionally, drawings were found and used, including the building plan and design, as well as an aerial shot of the collapsed building.

1.5 LIMITATION OF THE STUDY

Financial limitation: Research is often hindered by a lack of funding. Finding pertinent resources, books, or information is a difficulty for the researcher, as is gathering data via the internet, questionnaires, and interviews.

1.6 JUSTIFICATION OF THE STUDY

The high rate of building collapses at close intervals (such as the September 28, 2014, collapse of the Liberty Power Bible Church, Power Palace at Asoro Slope, offEkenwan Road in Benin City, and the June 4, 2012, collapse of the Central Hospital Building under construction at Sapele Road, Benin City) and the rising rate of building construction using substandard materials have made Edo a major concern in Nigeria, posing a threat to human lives and property in the state. There are reasons to stress the need for legal action to put an end to those calamities, as people construct buildings without taking into account certain criteria and codes that must be implemented before beginning any development.

One of the goals of this study is to educate the Edo State government about these collapse incidents and to give them the authority to enforce the law in order to protect the lives and property of the people who live in housing in general as well as the life of the buildings by making sure that safety and housing regulations are strictly followed. It also aims to educate developers, masons, and others about the importance of hiring professionals in construction to prevent structural failure and building collapse.

CHAPTER TWO

LITERATURE REVIEW

Many people in Nigeria are accustomed to building collapees. A building is said to have collapsed when a portion or the entire structure lost way abruptly, making it impossible for the building to fulfil its intended function. Building collapses have become a very shameful and embarrassing problem in the nation, particularly in the last five years, which is intolerable. The building's structural failure is the cause. We must understand that structural failure is the loss of a structure's stability or sustaining capacity, which is indicated by a significant increase in strain without a corresponding increase in load (Windapo, 2016). When a building collapses, a crucial part of the structure may rupture, which rises more quickly than the imposed load does. Building collapse happens when a structure abruptly collapses or breaks apart. Throughout the month of the rainy season for example, if a few shoddy, incomplete buildings were to collapse, countless people who were sheltering from the rain beneath them would be killed. The fortunate ones would be permanently disabled, while the unlucky ones would either pass away right away or wind up in the hospital for over the most of their lives.

2.1 BUILDING FAILURE AND CAUSES OF COLLAPSE FROM FLOODING

A building fails when it can no longer do what it was built to do. This happens when any part or the whole structure cannot safely carry the weight it was meant to hold. Small cracks or bends may seem harmless, but sagging floors, crumbling walls, or falling ceilings are clear signs that a building is in trouble (Wisner, 2014). Studying these failures helps engineers see weak points, learn from mistakes, and find ways to prevent future disasters (Obicchina, 2015).

2.1.1 Flooding as a Cause of Collapse

Floods are one of the most damaging natural forces for buildings. Water can wash away the soil under a building, making it unstable. Concrete, bricks, and wood weaken when soaked for long periods, and steel bars can rust quietly inside walls and floors. Water also pushes hard against walls, sometimes causing cracks or even total collapse. Buildings with poor drainage are especially at risk, as standing water speeds up decay. Other ways floods can damage a building include.

2.1.2 Reasons Flooding Can Cause Building Collapse

i. Floodwaters can wash away the soil supporting the foundation, making the building unstable or causing it to sink.

ii. Prolonged exposure to water weakens concrete, bricks, and wood, reducing their strength.

iii. Steel bars inside concrete can corrode when wet, which weakens the structure from within.

iv. Water pushes against walls and floors, creating cracks or even forcing walls to buckle.

v. Floating objects like logs, vehicles, or trash can crash into the building, causing structural damage.

vi. Floods can damage basements, drains, and pipes, affecting the building's stability.

vii. Standing water around the building accelerates decay of materials and foundation weakening.

2.1.3 Human Negligence and Flood Damage

Human actions often make flood damage worse. Some people build in flood-prone areas, use low-quality materials, or ignore proper drainage. Small water damage is often neglected, and unauthorized changes or poor maintenance weaken the building over time. These mistakes can turn minor flood problems into serious, preventable collapses.

2.2 EDO STATE AS A CASE STUDY

Latitude 0.734N and longitude 0.645E are the coordinates of Edo State. With the exception of the northern axis, where the Northern and Esan plateaus extend from the 183-meter-high Kukuruku Hills to the 672-meter-high Somorika Hills, it is low lying. With a population of nearly 3 million according to the most recent census, it is a small state with a land area of 19,794 km^2. In addition, the state is famous for its cashew nuts, rubber, and cocoa. It is also endowed with valuable stones including limestone, quartz, dolomite, and granite, which are used to create cement in Okpelia, one of Africa's most populated towns. The city, one of the nation's commercial and industrial hubs, has a dense population and a wealth of economic prospects, which has resulted in excessive use of the resources and services that are accessible. Land use is under strain as a result of the growing rate of urbanisation, etc

2.3 MAJOR CAUSES OF BUILDING COLLAPSE

When a structure reaches its limit state, it is considered to have failed. The point at which the structure is no longer appropriate for its intended purpose is known as the limit state (Bosede, 2014). This may be due to severe deflection, cracking, or other conditions that render it inappropriate. (Bankoff 2003) identified four fundamental phases of a building's life planning, design, construction, and services as the causes of building failures. (Oyewande 2004) expanded the list to include natural causes. However, as it includes non-natural causes like car crashes and fires, this could be categorised as circumstantial failure.

The following factors have been identified as the causes of construction failures in Edo State, Nigeria: design flaws product failure (10%), construction site defects (40%) and defects (50%).

According to Hewitt, the main reasons for structural failures are poor design, poor work execution, and the use of subpar materials.

2.3.1 Planning

In order to choose the most economical alternative, the planning stage entails evaluating a number of design options while keeping in mind the purpose the structure will serve.

2.3.2 Design Stage

Errors in figure computation are not the main indicator of bad design; rather, it is the neglect to consider the estimated load that the structure would support. Additionally, poor design is caused by incorrect ideas, dependence on faulty data, a lack of knowledge about the consequences of recurrent or impulsive pressures, and a poor selection of materials or a misinterpretation of their characteristics. These mistakes are made at the beginning and are the engineer's fault. The goal of structural design is to transfer to the foundation the many types of loads that a structure will probably experience during the course of its operation. The majority of writers blame poor design for building collapses (Oloye, 2010, Omenihu, 2016, Hassan, 2016, Adewole. 2014, Ayodeji, 2018). The term "design-related causes of building collapse" describes those factors that take place before a contractor is hired.

Decisions like site selection, project funding, and other responsibilities of the client and design team are all included in design-related concerns. Although it is typically assumed that the structural engineer would have taken into account every pertinent factor before to developing a design, this isn't always the case. In Nigeria, structural engineers are rarely charged with responsibility for building collapses.

This could be attributed to improper application of building design and construction regulations. Building collapses in Nigeria are attributed to policy control difficulties, such as inadequate town planning permission and development monitoring procedures (Oloyede 2010). Professionals claim that the government hardly ever sanctions planning controversy defaulters (Obot 2016). public to act as a disincentive to others who might want to take similar actions. In Nigeria, the protracted legal proceedings that typically follow building collapses frequently cause the public to lose interest in the cases and not follow them through to the end. Sometimes, clients' selection of challenging locations causes structures to collapse. [Olusola 2017] like flooded, artificial, and marshy areas. The usage of costly foundation types is required for problematic sites, for which the client might not have the necessary funds. The design team's experience has a significant impact on the results of construction projects using the traditional procurement approach, which is primarily used in Nigeria. The contractor is only hired to build a facility that has already been designed. Consequently, there are still design issues, such incorrect bearing assumptions. The soil's capacity may cause the building to collapse structurally, particularly if the contractor decides to build it precisely as planned. Therefore, conceptually, design-related elements influence a building's construction and could ultimately cause it to collapse. Typically, construction-related factors are thought to be the direct causes of building collapse. On the other hand, the remote causes can occasionally be linked to design.

2.3.3 Construction Stage

The primary cause of structural failure has been poor construction. In this case, the engineer is also at responsibility if the inspection was inadequate. This includes making concrete with salty sand or the incorrect kind of soil, using subpar steel instead of what is called for, incorrect riveting or even incorrect nut tightening tension, using a drift pin excessively to align holes, welds, and other procedures that the construction worker is familiar with. Typically, contractors are in charge of physically constructing a building on the property. There are restrictions on the contractor's work. He did not contribute to the design that was already created. The client has selected a site for him, which could present construction challenges. It is anticipated that the contractor already has the organisational capacity to overcome the project's construction difficulties. However, contractors can lack the necessary workforce to complete a project. Ifedolapo (Ejiofor 2018) noted that it is necessary to confirm the competences of people who design, approve, monitor, and install buildings in order to reduce the number of building collapses in Nigeria. Unfortunately, it is well known that Nigerian indigenous contractors frequently use quacks to oversee building projects. Both Hassan et al. (Hassan 2016) and Oloyede et al. (Oloyede, 2010) ascribed the reasons for building failure to poor construction techniques that arise from the usage of underqualified workers. Building collapses have been attributed primarily to the usage of quacks (Omenihu 2016, Hassan 2016, Essien 2017, Limaye 2014). According to several authors, shoddy construction is a major cause of building collapses in Nigeria (Omenihu 2016, Tanko, Lesanmi 2012, Ayodeji 2011, Yanuse 2017). The demise of the once-vibrant apprenticeship program in Nigeria's construction sector may be connected to this. In the past, it was typical for aspiring craftspeople to remain under the guidance of more seasoned craftspeople and only become self-sufficient after becoming proficient in their craft. Today's craftsmen typically only work for a short time with more seasoned craftspeople before going out on their own with little training or expertise. The use of subpar materials during construction can occasionally lead to building collapses (Oloyede 2010, Akinyemi 2016, Osteraas 2018, Fakere, A., Olusola 2011, Ayodeji 2011). The contractor or client may lower the quality of the materials specified by the building's designer in an attempt to lower construction costs. Poor-quality materials are either directly or indirectly encouraged by consultants' and contractors' compromises and other unethical actions. At the moment, there is no robust regulatory structure to guarantee that only high-quality materials are used in building construction. Despite being obligated to make sure the contractor used high-quality materials throughout construction, consultants can neglect this duty because of unethical "compromises with the contractor." Surprisingly, very few studies have attempted to classify the reasons of building collapse in Nigeria by statistical grouping them. An unsupervised statistical grouping technique is the most effective way to do this kind of grouping, which will avoid the biases of researchers and give stakeholders a place to seek for solutions in the event of a building collapse.

2.3.5 Service Stage

It should be made sure that the structure is not utilised for any purpose during the service phase that would result in the imposition of loads that exceed the design specifications. Some failures have resulted from this. Maintenance is a component that is frequently overlooked throughout the service stage. Certain systems, such as the sewage, electrical, and plumbing systems, deteriorate with use and need to be serviced on a regular basis. Other significant organisations exist in addition to these that contribute to degradation and, as a result, Buildings must receive the care they need to prevent eventual failure.

These organisations are

2.3.5 Disasters

The recurrence of disasters is the main reason why the global scene collapses. There are two categories of catastrophes. These categories include both man-made and natural calamities.

i. Natural Disasters: Heavy rains, volcanic eruptions, etc., might cause a building to collapse. Even though the customer, consultants, contractors, and others must have taken every measure, failure could still happen. Natural disasters like earthquakes, floods, thunderstorms, seepage, hurricanes, scour, extreme temperatures, and biological and chemical effects are all unavoidable in building design. One or more of these events may result in foundation or structural failure, and settlement due to the soil's compressibility may cause the building to collapse.

ii. Man-made disasters: are those brought on by human activity. These consist of mining operations, airline disasters, car accidents, bomb blasts, conflicts, and gas or chemical explosions. The effects of these disasters are similar to those of natural disasters, with the exception that structures may be completely grounded rather than buried in the ground.

2.3.6 Poor Implementation of Housing Policies

The intended technical, social, and economic outcome has not been attained due to the inefficient application of building regulations and planning controls, and all building professionals and controlling Before putting regulations in place, organisations are waiting for a collapse. The majority of homes in our urban and rural areas were either constructed without approved plans or the actual building actually strayed from the approved design, aside from the impact of some government agencies' developmental control functions, which are felt in very few homes. The structural stability of structures in industrialised nations is maintained for many decades, although this is not the case for Nigeria has a large number of buildings that exhibit indicators of deterioration within decades of their construction. It will be necessary to approve only certified structurally stable plans in order to properly execute and enforce housing policies. Additionally, it will necessitate inspections to ensure that approved plans are followed to the letter and that no deviations from the approved plan occur. The state of buildings in society can still be controlled by properly enforcing housing rules. Periodically, inspections are conducted to record the state of the existing structures. Suggestions are made that reveal structures that are about to crumble.

2.3.7 Unprofessional Conduct

Inappropriate demands on contractors' payments by CRs to confirm quality test results (even when they meet specifications), payment certificates, additional works to secure payments, etc. are all part of this national cankerworm that has spread over the entire country. Such unprofessional behaviour will unavoidably result in higher contractor costs. production that he needs to find a way to restore in order to continue operating.

2.4 EFFECTS OF BUILDING COLLAPSE IN EDO STATE

When performance falls short of expectations, it is considered failure. A failure may be regarded as taking place in a component when its primary activities can no longer be depended upon.

2.4.1 Abrupt Loss of Lives and Property:

It is unquestionably very serious when a building collapses because it always results in the unavoidable loss of innocent lives and their belongings. For example, the collapse of the new Central Hospital, a 109-year-old structure undergoing renovation in Benin City, killed an Italian professional. Many people avoid expenses, but they ultimately put people's lives in jeopardy and Moreover resources are being wasted.

2.4,2 Casualty

Although the heartbreaking and thought-provoking laments at the scene were quite moving, these have been the custom for many years because no building collapses have been documented in the past. Edo state, which hasn't caused any severe damage. Additional consequences of a building collapse include Homelessness, insecurity for those impacted, and on-scene theft.

2.5 SUPERVISION/INSPECTION (ENFORCEMENT ON SITE)

However, the builder is the only one who can supervise while the engineer or architect inspects the job. While inspection serves solely to guarantee conformity to contract agreements, particularly the designs, supervision entails a sophisticated understanding of workmanship and materials. According to Aqua Group, the main goal of supervision is to make sure that the expectations of the employers as stated in the contract terms are appropriately understood and that any issues that inevitably come up are satisfactorily resolved. Avoiding Effective labour supervision is crucial to preventing construction collapses.

2.6. PROTECTIVE MEASURES AGAINST BUILDING COLLAPSE

These steps are performed to prevent any residential building's structure from failing. According to Alexander (2019), the following actions will need to be implemented in order to ensure residential building structures continue to stay structurally stable.

2.6.1 Underground Moisture Management

Although moisture issues in existing basements are quite common, they are frequently misunderstood and improperly addressed. This might not be a major issue in a rarely used basement that is isolated from the living areas above. Nonetheless, ductwork or other openings connect the majority of Minnesota basements to the rest of the house. Furthermore, more and more people are using basements as finished living and sleeping areas. In certain situations, moisture issues can cause serious health issues in addition to being bothersome and uncomfortable. Wet carpets and under wall coverings can harbour mould and mildew. Finishing a basement without first addressing the moisture issues can cause serious damage and exacerbate existing health issues. Water issues in basements can be resolved, but doing it correctly comes at a price. There are several ways to address this issue, some of which are as follows:

Method 1: Correctly grade and install gutters and downspouts by appropriately managing surface drainage and precipitation utilising gutters and downspouts with extenders or splash blocks to move the water away from the foundation, many basement water issues can be resolved. It is crucial to slope the grade away from the home, as this may need transporting fill to the location. Since above-grade modifications may resolve the issue, this should be completed prior to the installation of any below-grade drainage system. Removing water as much as possible at the source is essential, even if a drainage system is needed.

Method 2: Drainage system outside Although it is the most expensive method of water control, installing an external drainage system at an existing building is the most efficient. To do this, the area surrounding the foundation must be excavated and rebuilt in a manner akin to that of a new home installation. Digging up bushes and other obstructions surrounding the house is also necessary. Along with any structural repairs, waterproofing and insulation are typically performed simultaneously. The backfill of conventional outside drainage systems is made of free-draining sand. You can lay drain tile over the footing or next to it. Installations of level drain pipes are satisfactory. The drain should have at least 12 inches of coarse material surrounding it.

2.6.2 Protection against Biological Attacks

Weatherising, or sealing the building, is one way to defend against biological threats. fissures surrounding the windows and doors. Windows and door cracks let outside air in and conditioned air out of the structure. Closing these gaps can improve energy efficiency and delay the rate of contamination by reducing the amount of air flow between the building and the environment. enters the structure from the outside.

Reducing the leakiness of the upper floors of large buildings exposed to extremely cold temperatures can significantly lessen stack effect flows, which is desirable because these flows have the potential to spread contamination quickly throughout the building and pollute stairwells that are required for evacuation.

There is a tiny exterior-surface-to-volume ratio in many huge buildings. Weatherization is unlikely to have a significant impact on lowering the number of casualties from an outdoor chemical or biological release in such buildings. However, in addition to potentially increasing safety against a chemical or biological assault, this upgrade may pay for itself in a few years through lower energy costs and better occupant comfort, particularly in the workplaces around the building's perimeter. The specifics of the cost-benefit trade-off will be determined by the local climate and energy costs, construction features (such the building shell's leakiness), and other variables.

2.6.3 Maintenance

Everything in the universe, including our planet and its inhabitants, is dynamic. The governing principles that prevent the universe's dynamic from becoming unmanageable are certain sets of universal rules. Natural principles prevent our ever-changing planet from deviating from its orbit. The gravitational force is an illustration of this concept. In addition, the soil renews itself and recycles its parts as a natural way to keep itself in good condition.

2.7 **The Roles of Government and Professionals in Mitigating the Occurence of Building Collapse in Edo State**

What solution is available to address irregularities in a building that have already demonstrated a feature or features of structural failure? Corrective measures, often known as remedies to structural failure, are any actions done to improve the problem. Three distinct headings will be used to explain these measures below:

2.7.1 The Role of the Federal Government

The issue is that the government is frequently held accountable. Even if we need a responsible government with the political will to enact regulations governing the construction business, the reality is that individuals oppose government initiatives, which makes enforcement challenging. Most of the time, building owners hire inept and unskilled individuals, use inferior materials, and treat specialists with contempt. Although it is a challenging task, I believe that we can reduce the frequency of building collapses provided professionalism is respected and the government has the political will to fulfil its regulatory responsibility. This is a result of certain so-called experts who are willing to sacrifice morality in order to increase money. Oyediran (2016) proposed that we have clients who are also unwilling to compensate those who are skilled in the field. Material producers are also complicit. The Nigerian Standards Organisation is a weakling in the eyes of 1 am. Consider the iron rod as an illustration of a crucial structural component.

There are two types of iron rods: diameter and length. You barely ever find a rod with a 12mm diameter when you go to the market. One inch is all you can get. Therefore, if the structural engineer fails to perform this task, the people who are expected to do the construction will also be unable to employ the precisely specified materials, which would lead to a subpar job. The short cuts made by the One of the issues that contributes to the problem of building collapse is producers. It is regrettable that building collapses continue to occur in Nigeria. The use of subpar materials during construction is one of the reasons why buildings fall. Furthermore, there isn't a comprehensive oversight by the appropriate governmental entities and agencies. A surveyor must inspect the site before to building or development; if the survey is inaccurate, it will have an impact on the structure. Therefore, the government of each state in the union should provide a survey. infrastructure to guarantee precise site surveying. The government should punish and hold contractors accountable for buildings that fall as a means of preventing building collapses.

Furthermore, the industry needs to enforce regulatory legislation. Some clients don't give a damn, and some experts don't do their jobs well. When a structure collapses, all the The engineers, surveyor, and architect who were involved should all be looked into so that the real culprit may be found and dealt with.

There are numerous laws and rules that govern the nation's property development and construction, however they are not upheld. People just do what they want to do; they don't follow the law. The government ought to enforce the rules and legislation pertaining to the construction sector.

Afodun (2016) emphasised that government should make sure that only qualified individuals are assigned to positions. In order for clients to only award contracts to legitimate specialists, there needs also be widespread education. Many people avoid expenses, but in the end, they waste money and put people's lives in danger.

It appears that every player in the building industry is somehow connected to building collapses. The government should, however, make sure that professionals are hired. Professionals such as architects and structural engineers must to be let to carry out their duties. Soil testing is also required. It is not always the case that a substance will work in another setting just because it worked in one.

Another factor contributing to structure collapse is cutting comers. Even with all the experts there, there are still some dishonest people. They are not employing the proper materials by the time they start building. The so-called experts are also altering some of the information, even when they are available. Therefore, careful supervision is crucial. I will recommend that the government constantly ensure that experts are engaged, appropriately overseen, and the appropriate supplies are purchased.

Oloyede (2016) stated that Building construction should be governed by legislation in every developed country and well- functioning society. These kinds of rules should be included in every country's construction code. Regretfully, over the years, Nigeria's National Building Code has not been approved by the National Assembly despite being presented for approval.

Second, the ministry of physical planning and urban development is obliged to have development control agents in every state. Every structure must go through the proper procedures before being constructed, which include submitting building plans for approval and checking that the required structural and architectural designs have been completed. Consequently, there will be fewer design failures. After then, construction will take centre stage, and the government must make sure that the on-site procedure follows the plan. The majority of issues arise on the site as a result of consumers failing to engage licensed professional builders to oversee the building production process. Additionally, the groundwork for failure has been established if quacks are employed.

Awobodu, (2016) observed that government needs to increase its workforce since they lack enough personnel to keep an eye on things on the ground. The issue of a building code and specification from the ground up should be addressed by the government by holding a national conference on development control. According to engineers who work on the site, development control under the government is failing, so the professional bodies should also band together and establish a development control resource centre. The government must enact particular laws and establish particular guidelines. For example, there should be guidelines to follow before a foundation is started. There must be specifications, testing, and someone to inspect the iron rods during the slab placement phase to make sure they meet acceptable standards before the blockwork stage begins. This needs to be completed all the way up to the roof. Monitoring should continue to the end because people die on slick floors.

Enough jobs in the monitoring field should be created by the government. Building checkers are present; they ought to be used. Then, everyone involved in the building construction chain should face severe consequences for failure.

Braide (2016) suggested that development control mechanism linked to insurance must be created, 90 that a building's insurance premium will begin to decrease when it is subjected to the appropriate control mechanism method, and that it will increase when it is not. In the event of a failure, such as the death of fifty people, the insurer will pay N10 million in compensation, and the building owner will be required to pay a bond of approximately N5 S00 million right away, even if he has to sell his property. As a result, developers will have to pay the appropriate professionals less for example, N5 million instead of N500 million. There must be a reward for cooperation and a penalty for violators if we are to enforce anything.

2.7.1.1 Redress from Federal Government for Losses Sustained Through Building Collapse In Nigeria

i. The government should collaborate with the Nigeria Institute of Builders (NIOBS), the Nigerian Institute of Architects (NIA), the Council for Regulation of Engineering in Nigeria (COREN), the Planning Authorities, and others.

ii. The buildings that have beyond repair should be demolished, and the ones that require rehabilitation should be restored whenever feasible.

iii. Professional associations and federal, state, and local government authorities should confront quackery and non-professionals.

iv To help, the government and municipalities should create mass housing units.

v the underprivileged. Additional resources, automobiles, staff, updated maps, and the safety of surveillance and it is necessary to guarantee enforcement personnel. The public should also be made aware of the problem and the ongoing rise in building collapse and to stay away from deteriorating buildings. In order to prevent collapse, clients and the general public should also be made aware of the importance of building according to standards, consulting experts, and avoiding inferior materials while building their homes.

2.7.2 The Role of Construction Professionals

a) The Architect

An architect is a competent individual who is hired to create the building's architectural blueprints. They also oversee the architectural work while it is being constructed and prepare the drawings for approval. Typically, the qualified architect is a registered architect with in enforce an architectural act-mandated practicing certificate.

b) Structural Engineer

The qualified individual assigned to create the building's structural designs is referred to by this name. To put it simply, the structural engineer creates structural drawings for approval and oversees the structural work as it is being built. The certified structural engineer needs to have an account with the area of structural or civil engineering that is governed by professional engineer's acts and has in Obtain a practicing certificate in accordance with that law.

c) Geotechnical Engineer

Plans for underground building construction that address geotechnical issues are prepared by geotechnical engineers for approval and to oversee the geotechnical components of the work during building. Under the professional engineer's acts, the qualified geotechnical engineer is a specialist registered in the geotechnical engineering branch and is now in practice. certified under such laws. Although a geotechnical engineer is only required for subterranean construction, a developer or builder should think about hiring a trained If the location has challenging ground conditions, a geotechnical engineer should be consulted for the geotechnical components of any work.

d) Quantity Surveyor

A quantity surveyor, sometimes known as a "cost engineer," is a professional in the construction business who focusses on determining the worth of construction projects. It is solely the quantity surveyor's responsibility to examine the priced invoices in detail and provide a report. The role that quantity surveying plays in quantifying the different resources, including labour, supervision, equipment, and materials, needed to build a particular project. From minor renovations to estimating the construction value of a brand-new, multi-millionaira road project, quantity surveyors use their expertise to estimate the cost of building projects. One important element of the design team is the quantity surveyor. The client who commissions a building project, the architect and engineers who design it, and the contractor who constructs it all depend on him. He is an authority on construction management, construction communication, and construction prices. He was referred to as the "design tight" of architects and engineers in the building and related sectors by Burgess (2018).

d) Building Service Engineer

Constructing Service By creating the electrical and mechanical systems that enable people to operate inside a confined structure, engineers give buildings life. Creating and maintaining a consistent interior environment with the ideal temperature, air quality, and lighting levels is a task for building service engineers. All essential backup support systems, including electricity, hot and cold water, and lifts, must be available. Installing life safety Additionally, systems like sprinklers, escape routes, and fire alarms are crucial.

e) Project Manager

Planning a specific construction project and monitoring its development are the main duties of the project manager. After reviewing a proposed project, the project manager decides how and when the work will be completed. In order to give the construction team a roadmap to follow and ensure a timely and productive completion of the project, the project manager also creates a deliverable timeline. To be ready to tackle duties that arise during the project, the construction manager or project manager needs to do a thorough assessment of the project (Obiechina, 2015). In addition to organising the job and ensuring its completion, the construction project manager is also in charge of overseeing the hard hat workers. This entails organising and leading construction workers' activities.

2.7.3 The Role of Building Regulatory Authority

Owners of buildings that are not structurally stable should be served notices that would inform them of the structural stability of their building and what measures to be taken within two specified periods. The purpose of building regulatory authorities is to conduct a vocation exercise of the structural stability of houses in their areas of authority with the aim of advising on the possible rectification where possible, while those that are beyond repair should be demolished before causing more harm. When such buildings are to be demolished, plans should be made right away to evacuate all residents, and then the building should be demolished. Regular monitoring of the condition of residential and commercial buildings is necessary, and building owners of structures that have been proven to have flaws should receive penalties or fines.

2.8 Review of Similar Previous Studies

Oke et al. (2019) identified poor design and structural miscalculations as leading causes of building collapse. They emphasized that many buildings fail because architects and engineers do not follow approved structural design specifications or ignore essential safety margins in load-bearing elements.

Olagunju et al. (2013) observed that many developers bypass formal construction procedures and ignore national building codes, often for financial or time-saving reasons, leading to unsafe structures.

Ayuba et al. (2020) in their study published in the *International Journal of Construction Research and Civil Engineering* reported that over 50% of collapsed buildings in Lagos involved the use of adulterated or expired cement.

Ameh and osegbo (2011) noted that inferior steel reinforcement, sometimes recycled or rusted, significantly reduces the structural integrity of buildings under load.

Olusola and Adesanya (2007) found that builders often use unwashed or mixed- grade sand and gravel, which negatively affects concrete workability and strength.

Ukoje and Kanu (2018) pointed out that many projects in Nigerian cities are supervised by unqualified artisans or technicians. This issue is especially common in informal construction sectors in cities like Benin, leading to poor-quality workmanship.

Ede (2010) emphasized that corruption among regulatory agencies undermines the enforcement of construction laws. Bribes and political influence often lead to building approvals without proper site inspection or adherence to safety codes.

Ebehikhalu and Dawam (2018) identified poor or absent soil testing as a major issue. Builders often fail to assess soil-bearing capacity, particularly in areas with high groundwater tables, resulting in differential settlement and foundation failure.

Lawal and Adewale (2013) reported frequent cases where buildings are constructed on unsuitable terrain like swamps and flood plains, which causes foundation movement and eventual collapse.

Anigbogu et al. (2021) noted that unauthorized additions (e.g., extra floors) were responsible for 30% of collapsed buildings in their study. These alterations often exceed the structural capacity originally designed for.

Omenihu et al. (2016) observed that contractors often rush construction processes especially concrete curing to meet unrealistic deadlines, compromising structural performance.

Okeola and Salami (2012) found that laborers frequently lack proper training, leading to improper concrete mixing, poor reinforcement placement, and inadequate compaction.

Ayedun et al. (2012) stated that inadequate monitoring of construction sites by professionals contributes to unchecked deviations from design standards.

Windapo and Rotimi (2012) identified illegal and informal construction as a significant issue. Many developers begin building without proper documentation, resulting in unsafe structural systems.

Ede (2014) discovered that unskilled workers frequently mix concrete by eye instead of following standardized mix ratios, compromising the compressive strength.

Fagbenle and Olawale (2010) emphasized that neglect of post-construction maintenance—such as crack repairs or damp proofing—leads to cumulative deterioration and eventual collapse.

Bamisile (2004) discussed the involvement of under-qualified architects or engineers in structural design, often driven by cost-saving motives.

Odunfa and Olorunoj (2015) showed that poor drainage systems in building layouts result in water accumulation near foundations, leading to erosion and subsidence.

Olagunju et al. (2013) pointed out that many old buildings continue to be used or expanded without any form of structural evaluation or rehabilitation, increasing collapse risk.

Olawale and sun (2010) found that many contractors and developers reduce costs by cutting corners skipping critical stages like soil testing or using fewer materials than required.

2.9 Research Gap Identified

Although several studies have investigated the causes of building collapse in regions like Nigeria and other developing countries, most existing research remains general, repetitive, or limited to post-collapse assessments without:

i. In-depth, data-driven risk modeling for predicting future collapse scenarios.

ii. Integration of geotechnical, structural, and human factors in a single framework.

iii. Real-time monitoring data or digital tools (e.g., BIM, sensors) to track construction integrity.

iv. Comparative regional analysis (urban vs. rural, coastal vs. inland) to understand local risk factors.

v. Preventive enforcement strategies tied to building code compliance and stakeholder behavior.

Few studies incorporate multidisciplinary methods combining engineering, urban planning, policy, and economics to propose sustainable, proactive solutions rather than reactive ones.

This gap underscores the need for predictive, location-specific, and technology-integrated evaluations of building collapse causes to reduce the frequency and impact of structural failure.

CHAPTER THREE

METHODOLOGY

3.1 INTRODUCTION

This chapter describes the study's methodology and data collection strategy. The following is how the chapter is structured. It will go into great detail about the research design, population to be sampled, sampling frame, sampling size, sample technique, data collection device.

3.2 DESCRIPTION OF STUDY AREA

Benin city is the Edo State in southern Nigeria, with a population of approximately 1.8 million people (2021) and an area of about 1,204 square kilometers (465 square miles). Auchi is a city in Edo state, Nigeria, and the headquarters of the Etsako West Local Government Area with estimated population of 150,000.

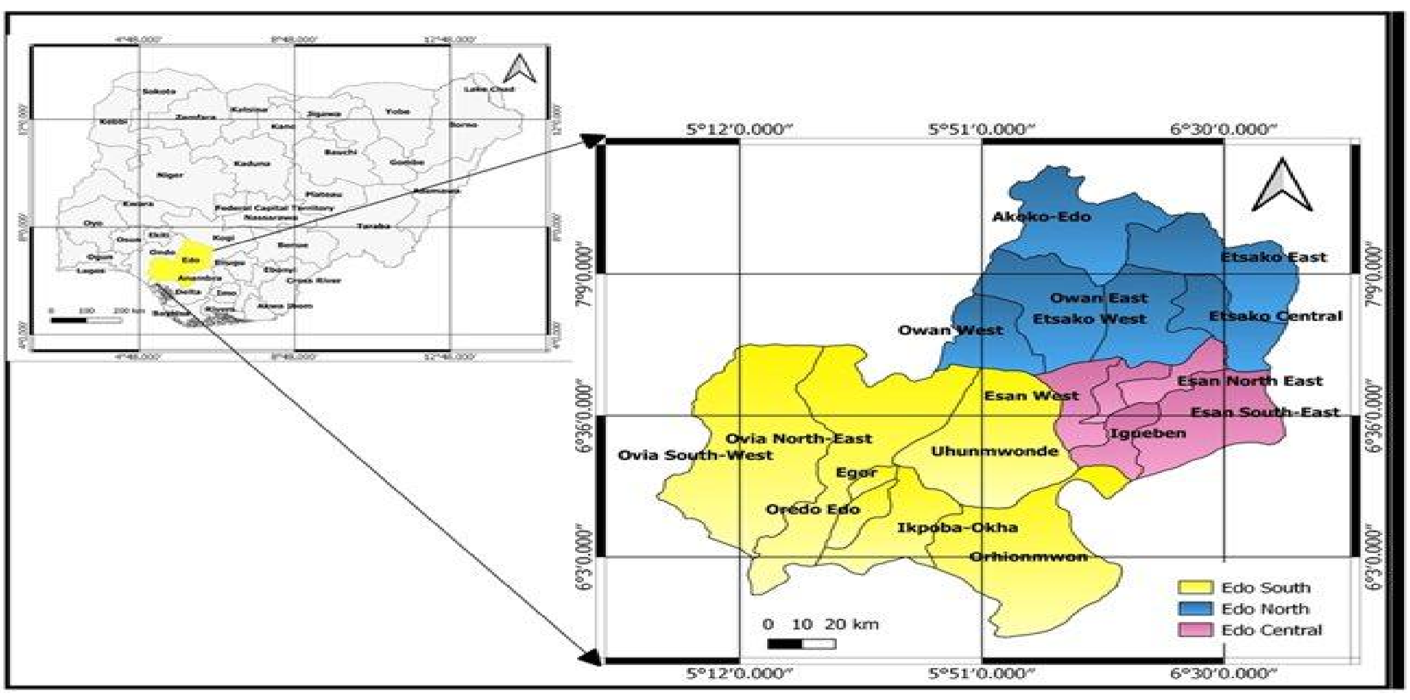

Figure 3.1a : Map showing the location of the state

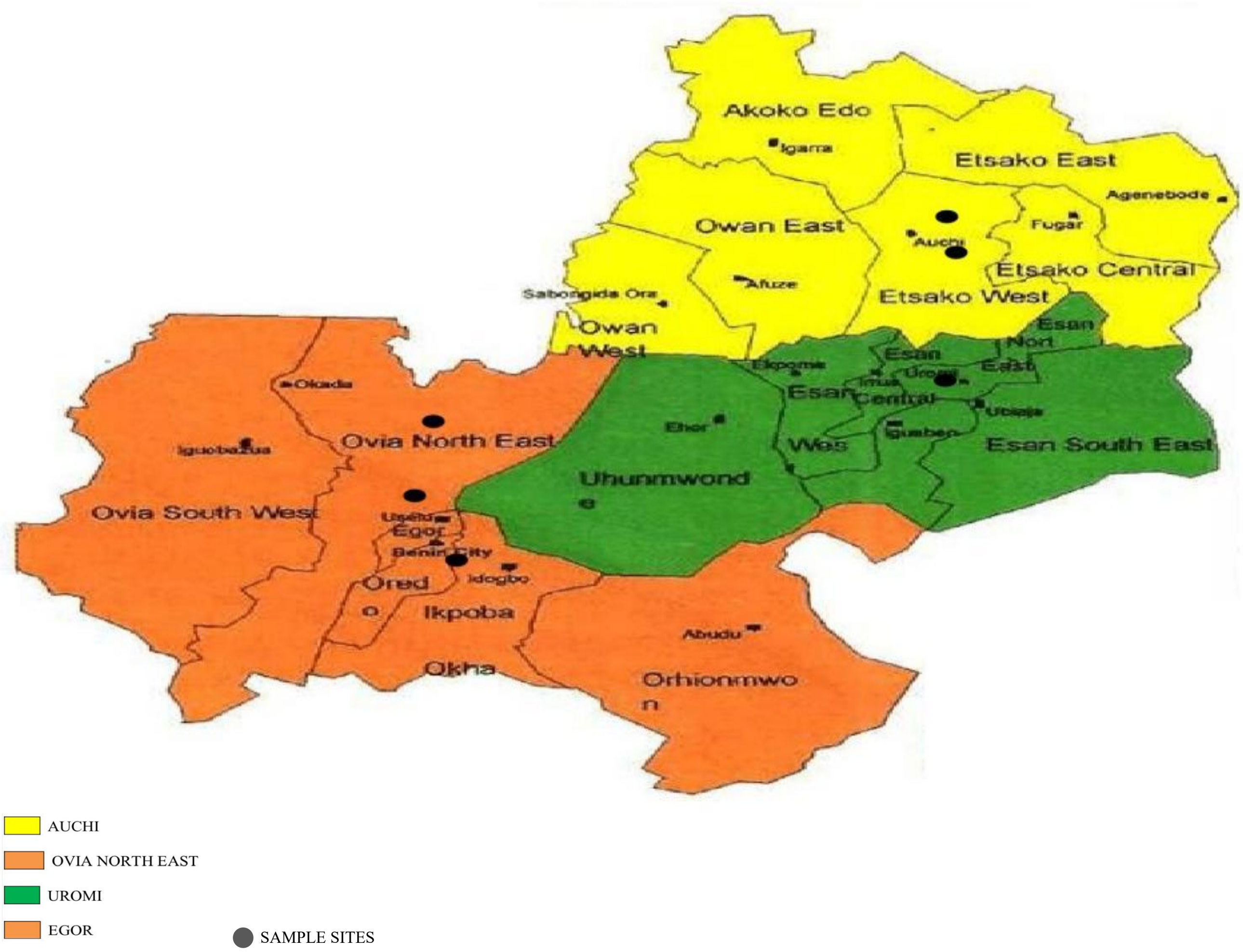

Figure 3.1b : Map indicating the study areas

3.3 RESEARCH DESIGN

This study was conducted using a survey study and the case study approach in-depth investigation of selected collapsed building sites to gather primary data and contextual information. This is because it allows for site inspection and data gathering, the survey study was best suited for the research. This case study method enable a focused examination of actual building collapse within Edo State, providing a practical framework for understanding the complex factors contributing to structural failure. Selected cases were analyzed based on severity, location, type of structure and accessibility.

RESEARCH METHODOLOGY

Fig 3.2 Flow chart of methodology

By looking into previous building collapses in Nigeria, pertinent information was gathered from secondary sources. Analysis of historical records from internal and external sources (pertaining to different building collapse incidents in Edo State) was used as a research tool to collect secondary data. The Nigeria Institution of Buildings provided some of the data (regardless of the location and based on the information that was available), and earlier studies works and different newspapers (via their website and the dailies):

The following descriptive and analytical tools were used to analyse the data that was gathered. scientific techniques: regression, correlation coefficient, Pearson product moment, and percentiles examination. Coefficient of Pearson Product Moment Correlation (r): This approach was used in this study. to evaluate the causes of building collapse and their causal link. The following illustrates Okonko's (2001) rationale for decision-making: The relationship between the correlation coefficient and the nature of the relationship is displayed in Table 3.1.

Table 3.1: Correlation coefficient and relationship type

Correlation Coefficient	Nature of Relationship
0.0 to 0.30 (0.00 to -0.30)	Little or no correlation
0.30 to 0.50 (-.30 to -.50)	Low positive (Negative) correlation
0.50 to 0.70 (-.50 to -.70)	Moderate positive (Negative) correlation
0.70 to 0.90 (-.70 to -.90)	High positive (Negative) correlation
0.90 to 1.00 (-.90 to -1.0)	Very high positive (Negative) correlation

3.4 DATA COLLECTION INSTRUMENT

The findings of laboratory tests on samples taken from the locations (building collapse sites visited) and also through a well-structured questionnaire survey were used to compile the study's data. Because of the qualitative nature of the investigation, this method was employed. of this study.

3.5 METHOD OF DATA COLLECTION

Auchi, uromi and Benin City in Edo State provided the data. These data were gathered from the primary building collapse sites throughout this town and city, specifically Federal Girls Junction, Off Ugbowo Road, Benin City; Idumoza community of uromi, Edo state; Ekhator street, off Edo street, Ekosodin Benin city; No. 22 Egbeadokhai Street, Auchi; and No. 30 Inu-Umuru Street, Auchi, because the research study involves the use of the case study method. Additionally, data was gathered using surveys with closed-ended questions. Professionals working in Edo State's building industry, including as quantity surveyors, architects, and civil engineers, were given these questionnaires.

3.6 COLLAPSE SITE ANALYSIS

The five selected cases underwent the following analyses to assist in identifying the real cause or causes of Edo State building collapses. It consists of

3.6.1 CUBE TEST

An overview of all the properties of concrete is given by the concrete cube test's compressive strength. One can determine whether or not concrete has been done correctly with this one test. For commercial and industrial buildings, concrete's compressive strength ranges from 15 MPs (2200 pai) to 30 MPa (4400 psi) and above.

Numerous elements, including the water-to-cement ratio, cement strength, concrete material quality, quality control during the production process, etc., affect the concrete's compressive strength. The ability of a material or structure to support loads on its surface without cracking or deflecting is known as compressive strength. When a material is compressed, its size tends to decrease, but when it is under tension, its size tends to increase. Compressive strength tests are performed on a cube or a cylinder. Cube samples were used for the compressive strength test in this investigation. A concrete cube or cylinder is suggested by several standard codes as the typical specimen for the test.

The measurements of the samples in each case were first taken in order to conduct this experiment. The cube and the testing machine's bearing surface were positioned within the machine so that the load would be applied to the cube's opposing sides. The specimen was positioned in the centre of the machine's base plate. The moveable part was manually turned until it touched the specimen's upper surface. Without causing any shock, the load was applied gradually and continuously until the specimen fails, at a rate of 140 kg/cm/minute. This was carried out for the harvested blocks in every situation.

3.6.2 STRUCTURAL ANALYSIS

Since it directly addresses the structural integrity and strength of buildings or structures, structural design is a crucial component of most civil engineering. Prior to incorporating creative designs into the structure, structural designs are used to guarantee its stability and safety. These designs also assist in providing all necessary information regarding the foundations, walls, floors, types of soot, steep beams, material quality, and other aspects to guarantee that the structure is constructed safely and soundly. To learn more about the foundations, walls, floors, beams, and columns, the structural studies of the five cases were examined in this study. This is done to determine whether structural failure that is, the failure of any of the structural components was the cause of the collapse. participants). The concepts of structural design and design were taken into consideration when conducting this analysis.

3.6.3 QUESTIONNAIRE

The research utilized a structured questionnaire, validated by three experts and tested using the Cronbach's Alpha technique. The Data for this study was collected by direct contact with the respondents. Research tools called questionnaires are made up of a list of enquiries used to elicit data from participants. They offer a rapid and effective means of gathering data from a specific audience or from a sizable sample of people. For these reasons, a well-structured questionnaire was used in this study to gather data from professionals in the field of civil engineering regarding the causes and consequences of building collapses in Edo State, as well as strategies to lessen their frequency.

3.7 VALIDITY TEST

According to Dilman's study (quoted by Oni, 2010), the questionnaire should be pre-tested with involvement from various groups, including coworkers and possible data users. Therefore, the first draft of the questionnaire needs to be provided to the researcher's supervisor and pre-tested among colleagues in order to ensure that the data obtained is complete and to create the most effective data analysis firm. Before a general survey is conducted, the questionnaire should be improved based on the feedback and results from the data.

3.8 METHODS OF DATA PRESENTATION AND ANALYSIS

To process these data accurately, the right data analysis technique must be used. As a result, this project is analysed using the case study method. For academics engaged in qualitative research, the case study method is the most popular approach in academia (Baskarada, 2014). Without being aware of the variety of circumstances that can influence the results of their research, research students choose the case study as their strategy. Since conducting research takes a significant amount of time and resources (Oce 2020), any kind of misunderstanding about the goal of the study, how the methodology should be applied, and how to validate the results could have unanticipated negative effects (Baskarad, 2014).

Compared to qualitative approaches, the majority of business researchers receive more training in quantitative methods due to the methodology's enduring significance (Eriksson & Kovalainen, 2015). Second, it has been noted that when conducting research, management researchers have a relatively small range of methodological approaches to choose from (Bazelcy, 2015; Molina-Azorin & Cameron, 2015). "This research presents an easy-to-read, practical, experience-based, step-by-step guided path to select, conduct, and complete the qualitative case study successfully." The numerous case studies used in this study as an application of step-by-step guidelines are specifically made to assist these business and management researchers. As previously stated, the goal is not to review or critique the body of current case study technique literature. Instead, an attempt is made to summarise our existing knowledge for novice researchers, which will save them time and guide them in the correct direction.

CHAPTER FOUR

4.1 DATA PRESENTATION AND ANALYSIS

The examination of the data gathered by field surveys (structured questionnaires), laboratory studies, and structural analysis is the main focus of this chapter.

4.2 COLLAPSE SITE ANALYSIS

The compressive strength of blocks taken from the collapse sites used in this investigation is displayed in Table 4.1.

Table 4.1: Compressive Strength of Blocks Harvested From the Collapse Sites

S/N	SAMPLES	COMPRESSIVE STRENGTH (N/MM^2)
1	Case 1	13.85
2	Case 2	12.14
3	Case 3	9.91
4	Case 4	15,89
5	Case 5	8.56

Table 4.2 provides information on the structural detailing of the individual cases.

Table 4.2: Structural Detailing of the Collapse Sites

Case 1	Depth of Footing	4.2m below ground level
	Type of Foundation	Shallow foundation
	Size of beam	355mm x 320mm
	Beam reinforcement	2 bars of 10mm thickness bottom, 2 bars of 10mm top
	Size of column	200mm x 260mm
	Column reinforcement	4 bars 10mm steel @120mm c/c

	Thickness of slab	97.5mm (3.8”)
	Slab reinforcement	Y10@100mm c/c
	Grade of concrete	M20
Case 2	Depth of Footing	4m below ground level
	Type of foundation	Shallow foundation
	Size of beam	300mm x 310
	Beam reinforcement	2 bars of 8mm thickness bottom, 2 bars of 8mm top
	Size of column	225mm x 250mm
	Column reinforcement	4 bars 10mm steel @120mm c/c
Case 3	Depth of Footing	3.6m below ground level
	Type of foundation	Shallow foundation
	Size of beam	350mm x 320mm
	Beam reinforcement	4 bars of 12mm thickness bottom, 2 bars of 10mm top
	Size of column	225mm x 250mm
	Column reinforcement	4 bars 12mm steel with stirrups of 8mm @150mm c/c
Case 4	Depth of Footing	3.9m below ground level
	Type of foundation	Shallow foundation
	Size of beam	290mm x 280mm
	Beam reinforcement	2 bars of 8mm thickness bottom, 2 bars of 10mm top
	Size of column	200mm x 260mm
	Column reinforcement	4 bars 10mm steel @120mm c/c

Case 5	Depth of Footing	3.8m below ground level
	Type of foundation	Shallow foundation
	Size of beam	300mm x 280mm
	Beam reinforcement	2 bars of 10mm thickness bottom, 2 bars of 10mm top
	Size of column	200mm x 250mm
	Column reinforcement	4 bars 8mm steel @120mm c/c

The figure below display the results gotten from the questionnaires distributed.

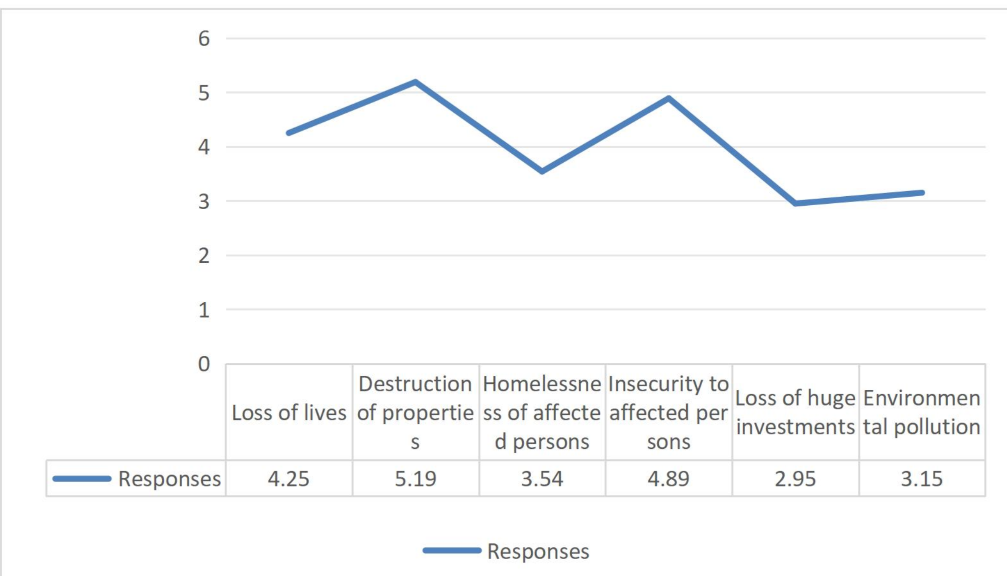

Figure 4.1: Questionnaire Responses on the Effects of Building Collapse in Edo State Nigeria

Fig 4.1 shows the identified effects of building collapse in Edo state. Destruction of properties was ranked 1st, insecurity to affected persons was ranked 2nd, loss of lives was ranked 3rd, homelessness of affected persons was rank 4th, Environmental pollution was ranked 5th, lost of huge investments was ranked 6th.

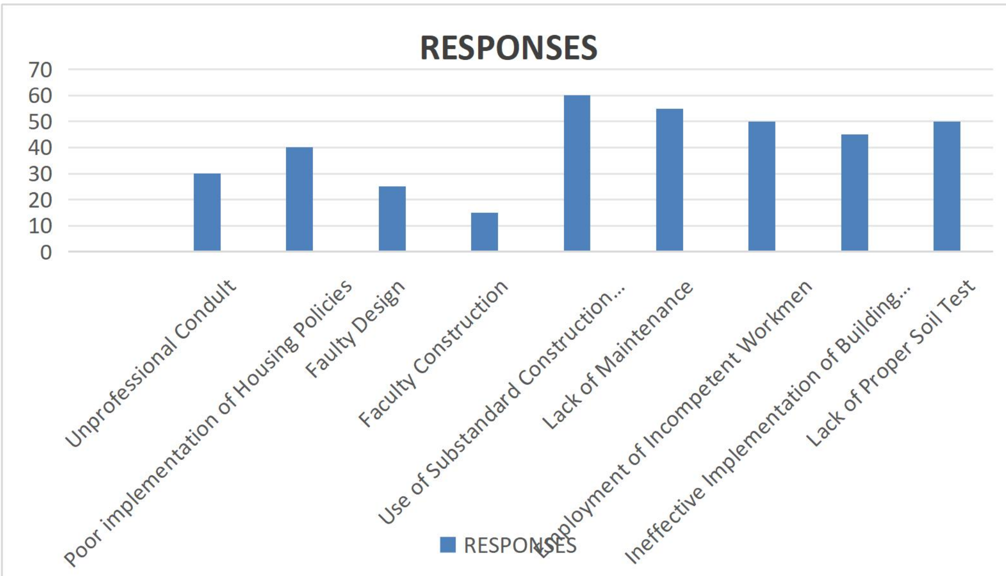

Fig 4.2: Questionnaire Responses on the causes of Building Collapse in Edo State

Fig 4.2 reveals the identified causes of building collapse in Edo State from the registered respondents. It reveals that the identified causes such as; Use of substandard construction materials which was ranked 1st, lack of maintenance was ranked 2nd, employment of incompetent workmen and lack of proper soil test were both ranked 3rd, ineffective implementation of building was ranked 4th, poor implementation of housing policies was ranked 5th, unprofessional conduct was ranked 6th, faulty design was ranked 7th, faulty construction was ranked 8th.

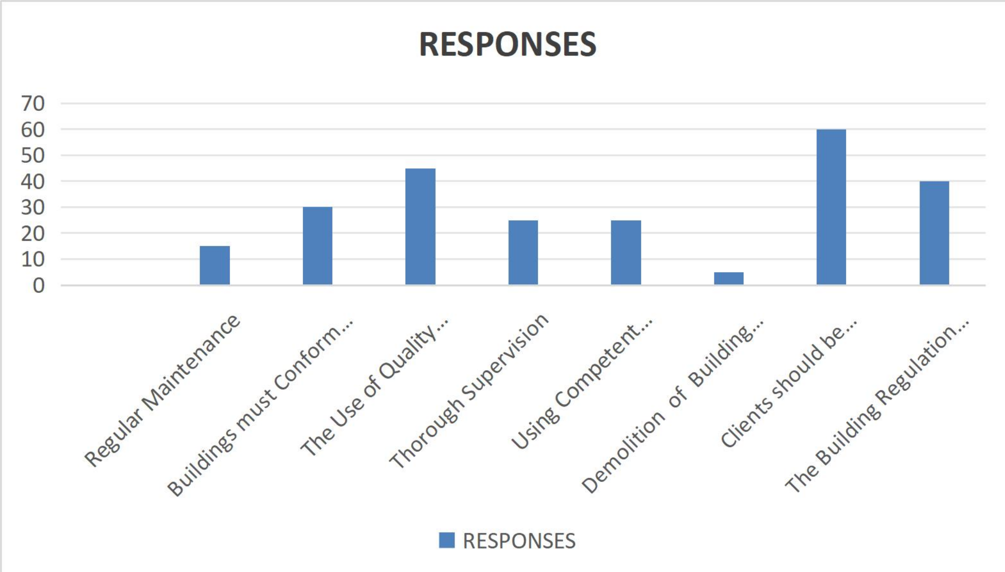

Fig. 4.3: Questionnaire Responses on the Measures to Mitigate the Occurrence of Building Collapse in Edo State.

Fig. 4.3 reveals the measures to mitigate the occurrence of building collapse in Edo state. It shows that clients should be sensitive of quality works was ranked 1st, the use of quality construction materials was ranked 2nd, the building regulation should be adhere to was ranked 3rd, building must conform to specifications was ranked 4th, thorough supervision was ranked 5th, using competent professionals was ranked 6th, regular maintenance was ranked 7th and lastly demolition of building that have gone beyond repair was ranked 8th.

4.3 ANALYSIS OF THE COLLAPSE BUILDINGS

In accordance with the case-study methodology employed in this work, the reasons behind the different building collapse cases were examined.

4.3.1 Collapsed building Site at Federal Girls Junction, Off Ugbowo Road, Benin City, Edo State - Case 1

Type of building - Public

Purpose of building - Commercial

No. of floors - 2

Date of Collapse - 2020

Calamities-Nil

Type of building contractor - Indigenous

According to the experimental and structural analysis, the use of inferior building materials, poor design standards, and blocks with low compressive strength are the main reasons for the collapse in case 1. The concrete has a relatively low compressive strength, and using subpar construction materials is one of the key causes of low compressive strength, which is also one of the top causes of building collapse according to the questionnaire results. The blocks taken from the collapsed building site (case 1) had a compressive strength of 14.04 N/mm2.

According to the structural analysis's results, the building was constructed with a column that was 200 x 260 mm in cross-sectional size and had four 10 mm steel bars at a distance of 120 mm c/c, rather than the required minimum size; 225 x 300 mm with four 12 mm bars and stirrups of 8 mm steel rings spaced 150 mm c/c; a beam that was 355 x 320 mm with two bars of 10 mm thick at the bottom and two bars of 10 mm at the top, rather than 350 x 350 mm; and a slab that was 97.5 mm (3.8") thick instead of 125 mm (5). The foundation satisfied the I depth minimum requirement. The most frequent causes of incorrect structural design are inept hiring practices and a lack of professionalism.

4.3.2 Collapsed Building Site at 30, Inu-Umuru Street, Auchi, Edo State - Case 2

Type of building - Private

Purpose of building - Residential

Date of Collapse - 2012

No. of floors - 1

Calamities - 2

Type of building contractor - Indigenous

Results gained from this research reveal that the causes of collapse in instance 2 include low compressive strength of blocks and inadequate structural design. The harvested block from Case 2 was likewise found to have a low compressive strength, with a measure of 12.60 N/mm2, which may have contributed to or been the cause of the collapse. However, the design results indicate that a shallow foundation with a 4 m footing depth and a 225 x 250 mm, 4 bars 10mm steel @120mm c/c as opposed to the standard minimum size; 225mm x 300mm cross-sectional column were used to erect the building with 4bars of 12mm with stirrups of 8mm steel rings at a distance of 150mm c/c; beam size of 300mm x 310mm, 2 bars of 8mm thickness bottom, 2 bars of 8mm top as opposed to 350mm x 350mm, 2 bars of 12mm thickness in the bottom and 2 bars of 10mm at the top of the beam; and this analysis says that the design specification are slightly off the minimum standard.

4.3.3 Collapsed Building Site at Idumoza community of uromi, Uromi, Edo State - Case 3

Type of building - Private

Purpose of building - Commercial

No. of floors - 2

Date of Collapse - 2025

Calamities- 1

Type of building contractor - Indigenous

Analysis reveals that the collapse in instance 3 occurred due to the use of substandard materials, the owner used smaller sized rods for the pillars and the structure lacked proper foundation. The case analysis reveals a column measuring 225 x 250 mm with four 12 mm steel bars and stirrups of 8 mm steel rings at 150 mm c/e; the beam is 350 x 320 mm with two bars of 12 mm thickness at the bottom and two bars of 10 mm at the top, rather than 350 x 350 mm with two bars of 12 mm thickness at the bottom and two bars of 10 mm at the top. The footing is 3.6 meters below ground level, which is less than the required minimum of 4 meters.

4.3.4 Collapsed Building Site at Ekhator Street, off Edo Street, Ekosodin, Benin city, Edo State - Case 4

Type of building - Private

Purpose of building - Residential

No. of floors - 3

Date of Collapse-2024.

Calamities-Nil

Type of building contractor - Indigenous

In Case 3, it was determined that the building's flawed structural design was the reason for the collapse. According to tests, the block sample in Case 4 has a compressive strength of 16.58 N/mm2, which is more than the required minimum. Therefore, the building's collapse could not have been caused by this reason. Examining the case's structural details, the building was built with a 200 x 260 mm cross-sectional column, four 10 mm steel bars spaced 120 mm apart; a 290 x 280 mm beam with two 8 mm thick bottom bars and two 10 mm thick top bars; and a 3.9 m foundation depth. According to investigation, the collapse was most likely caused by heavy downpour and the design criteria since they do not adhere to the minimal requirements for structural design.

4.3.5 Collapsed Building Site at 22, Egbeadokhai Street, Auchi, Edo State - Case 5

Type of building - Private

Purpose of building - Residential

No. of floors - 1

Date of Collapse - 2010

Calamities - Nil

Type of building contractor-Indigenous

The building's collapse was caused by poorly designed structural elements and blocks with extremely low compressive strengths.

With a reported compressive strength of 8.41 N/mm2, Sample 5 (Case 5) had the lowest strength of all the samples.

Contributing to this is the fact that, in contrast to the standard minimum size and reinforcement, the building was constructed with a column of cross-sectional dimensions of 200 x 250 mm with four bars of 8 mm steel @ 130 mm c/c; 300 x 280 mm with four bars of 12 mm and stirrups of 8 mm steel rings at a distance of 150 mm c/c; and a beam size of 300 x 280 mm with two bars of 8 mm thick at the bottom and two bars of 18 mm at the top, as opposed to 350 x 350 mm, two bars of 12 mm in the bottom and two bars of 10 mm at the top of the beam. Additionally, it was discovered that the footing was 3.8 meters below ground level.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSIONS

Based on the three objectives of this study, it is concluded that the major causes of building collapse in Edo State stem from a combination of technical, administrative, and human factors. The investigation revealed that poor workmanship, use of substandard materials, inadequate design, and non-compliance with building regulations are the leading causes of collapse. Many construction projects in the state are carried out without proper supervision by qualified professionals, while some developers deliberately bypass regulatory processes to reduce costs. This disregard for construction standards, coupled with weak enforcement by government agencies, creates conditions that make structural failures almost inevitable.

The effects of these collapses have been devastating, resulting in loss of lives, destruction of valuable property, displacement of families, and a decline in public trust in the construction sector. Economically, frequent building failures have discouraged investment in the real estate industry and burdened the government with emergency response and rehabilitation costs. Socially, victims often suffer trauma, loss of livelihood, and long-term instability, while the overall image of the state's urban development efforts is tarnished.

Furthermore, the study found that both government institutions and construction professionals have crucial roles to play in reducing the occurrence of building collapse. However, the current level of commitment from these stakeholders has been insufficient due to issues such as corruption, poor monitoring, and lack of accountability. Government agencies responsible for building approvals and site inspections often lack the manpower, resources, or integrity to enforce compliance effectively. Similarly, some professionals compromise ethical standards by endorsing substandard works or materials for financial gain.

Therefore, to address these challenges, there is a pressing need for stronger regulatory enforcement, continuous professional training, and stricter penalties for violations. Collaborative efforts between the government, professional bodies, and the public will be essential in promoting transparency, ensuring adherence to standards, and cultivating a culture of responsibility in the construction industry. Only through such sustained and coordinated actions can Edo State achieve safer, more resilient, and sustainable built environments.

5.2 RECOMMENDATION

The findings from this study will greatly aid policymakers in their efforts to identify long-term solutions to Edo State's building collapse threat.

i. Professionals with a high degree of integrity who prioritize ethical standards over other factors should make up the development control department.

ii. Attending workshops and forums will help builders and developers stay up to date on the latest advancements in the construction business. Additionally, stakeholders in the building environment need to be re-certified and retrained.

iii. Before granting construction approval, planning authorities should be furnished with accurate structural design calculations and drawings.

iv. Planning officials should make sure a customer hires a certified engineer to oversee his project.

v. In order to prevent failure, all building and construction industry sectors should stick to their areas of expertise.

vi. Planning authorities should use qualified engineers to accurately verify structural calculations and drawings in order to guarantee correct design.

vii. When there are questions about the information utilized for a building's foundation design, planning authorities should insist on a soil study.

viii. Building industry professional societies ought to create training programs that help recent graduates integrate into their communities and follow good professional practice.

iv. Conduct proper site surveys to identify flood-prone areas before construction begins.

x. Design strong foundations that can withstand water logging and soil erosion.

xi. Install effective drainage systems around buildings to prevent water accumulation.

xii. Elevate buildings in flood-prone zones using stilts or raised platforms.

xiii. Use water-resistant materials for foundations and lower walls where flooding is likely.

xiv. Keep records of past collapse cases in Benin City, Ekpoma and Auchi to guide future safety decisions.

xv. Update building rules using the key issues identified in the study such as weak blocks, poor supervision, design errors and flooding.

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APPENDIXES

CASE 1: Collapsed building Site at Federal Girls Junction, Off Ugbowo Road, Benin City, Edo State

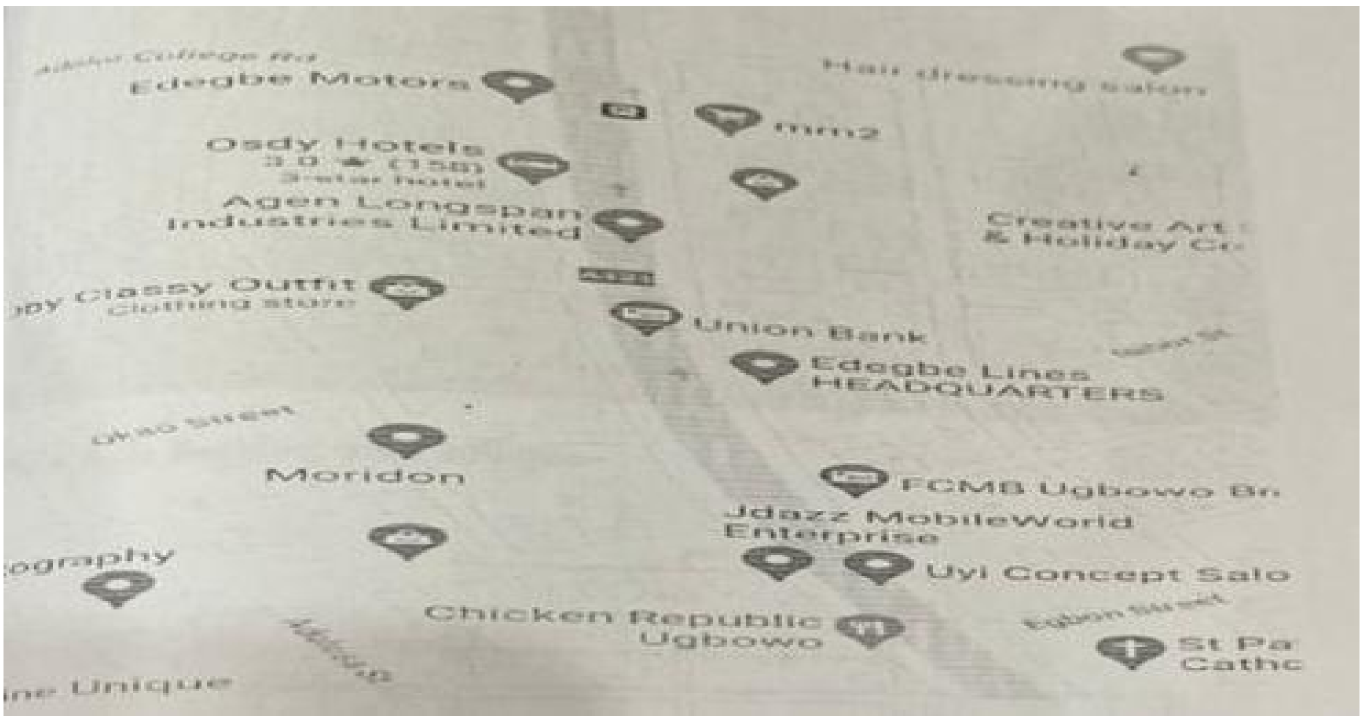

Figure A - 1: Map showing location of case 1

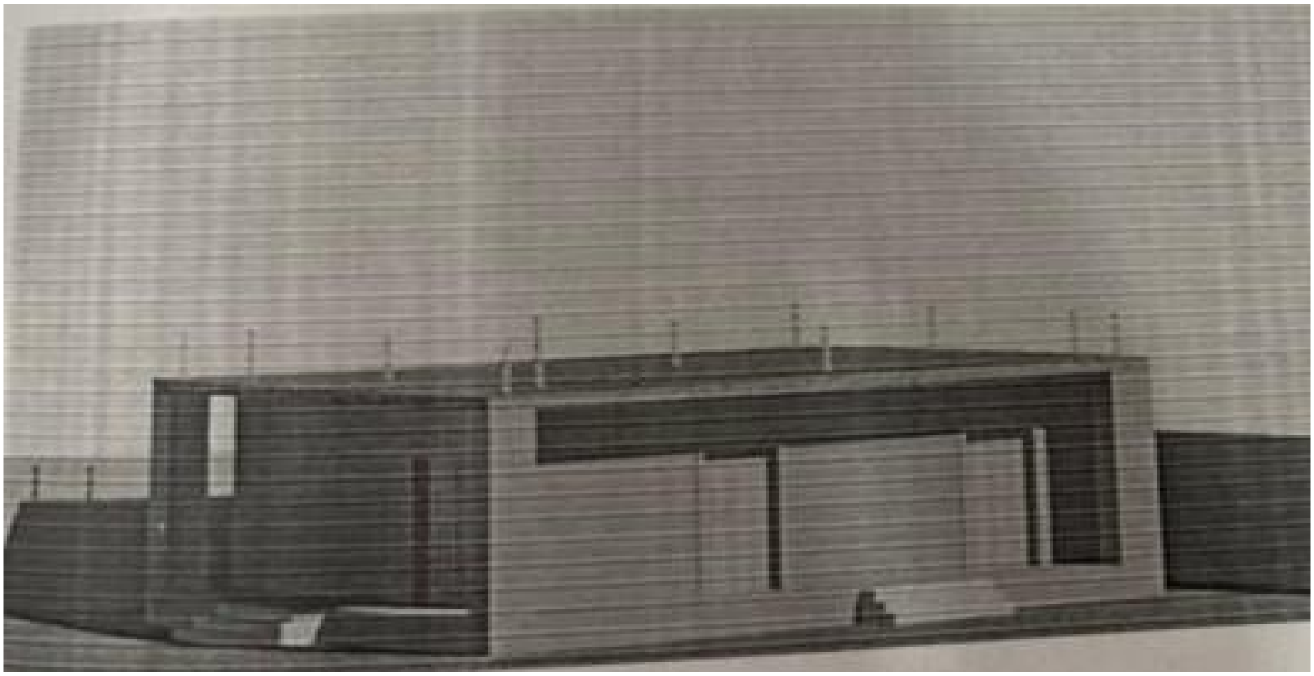

Figure A - 2: Building before collapse

Plate A - 3: Building after collapse

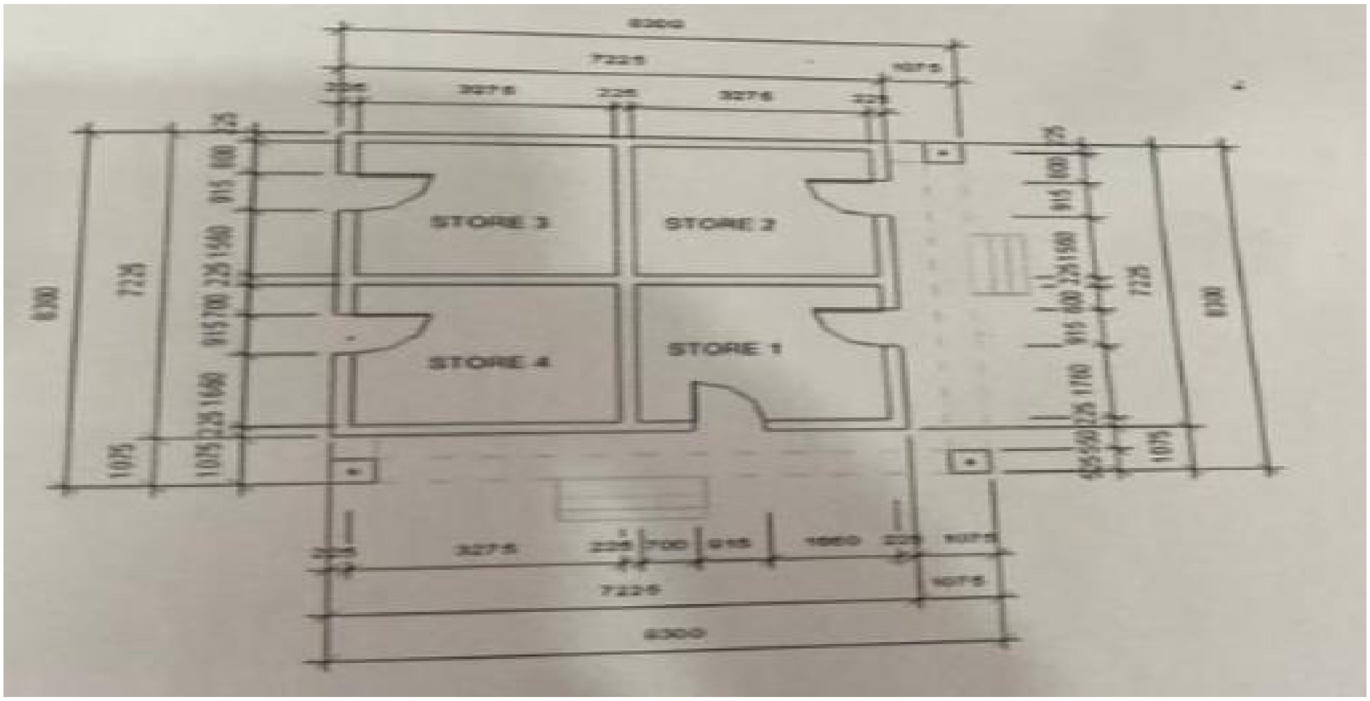

Figure A - 4: Building plan

CASE 2: Collapsed Building Site at 30, Inu-Umuru Street, Auchi, Edo State

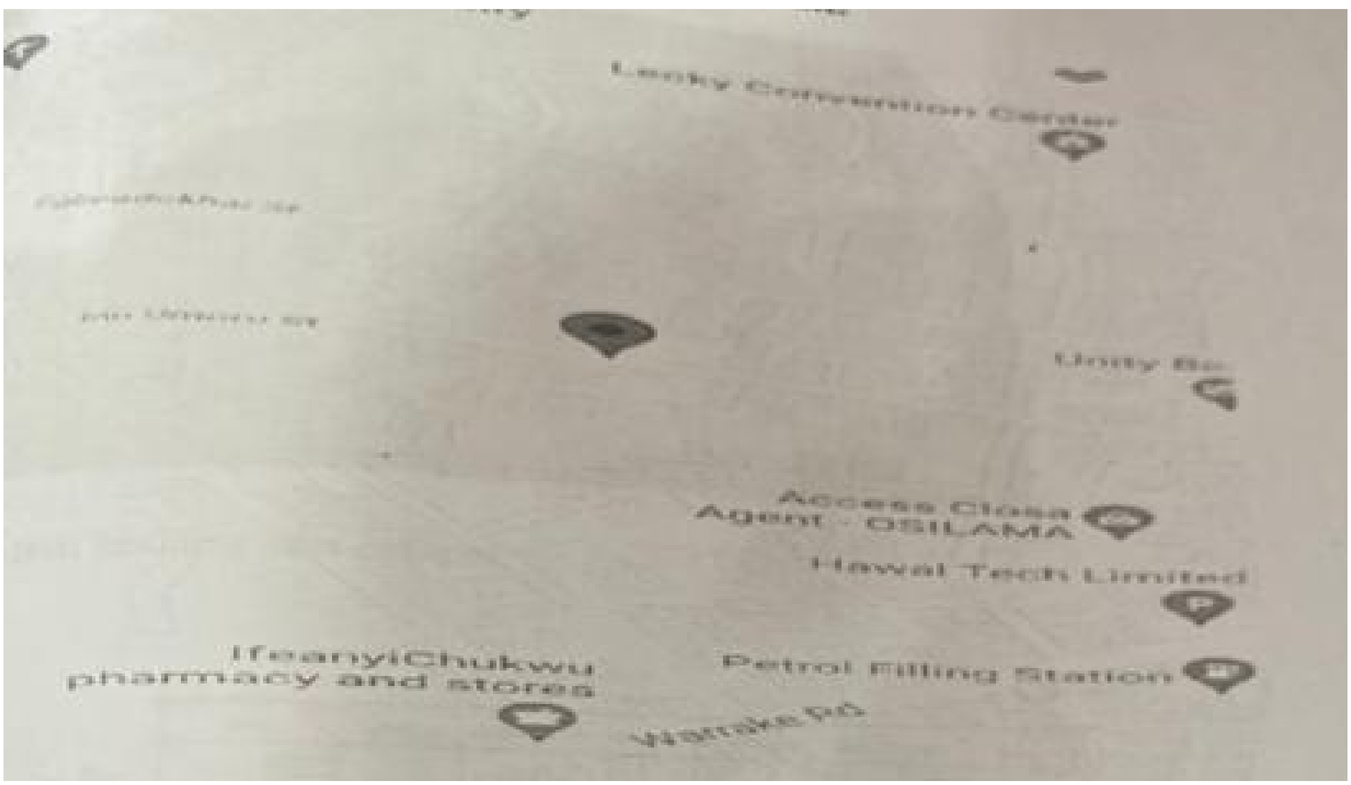

Figure B - 1: Map showing location of case 2

Plate B - 2: Building before collapse

Plate B - 2: Building after collapse

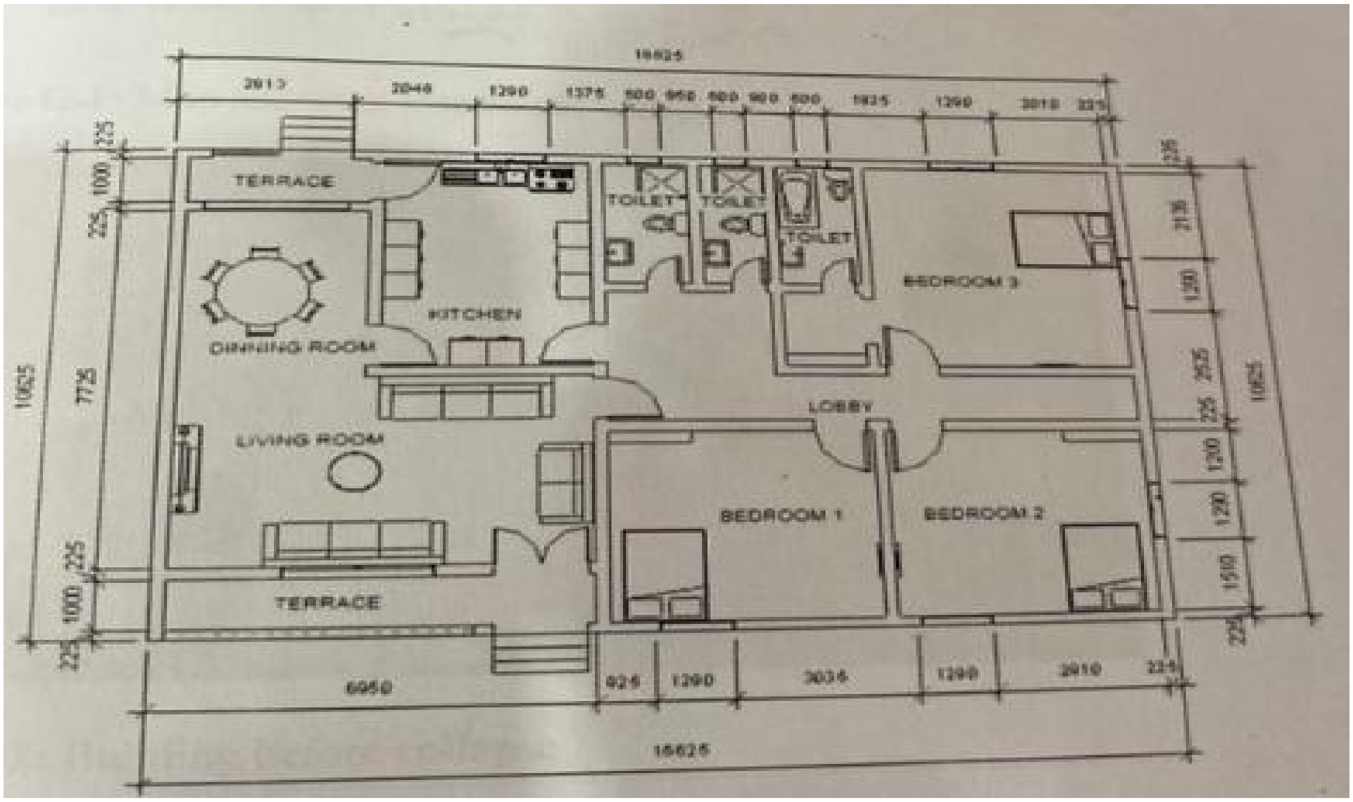

Figure B - 4: Building plan

CASE 3: Collapsed Building Site at Idumoza community of uromi, Uromi, Edo State

Figure C - 1: Map showing case 3

Plate C - 2: Building before collapse

Plate C - 3: Building after Collapse

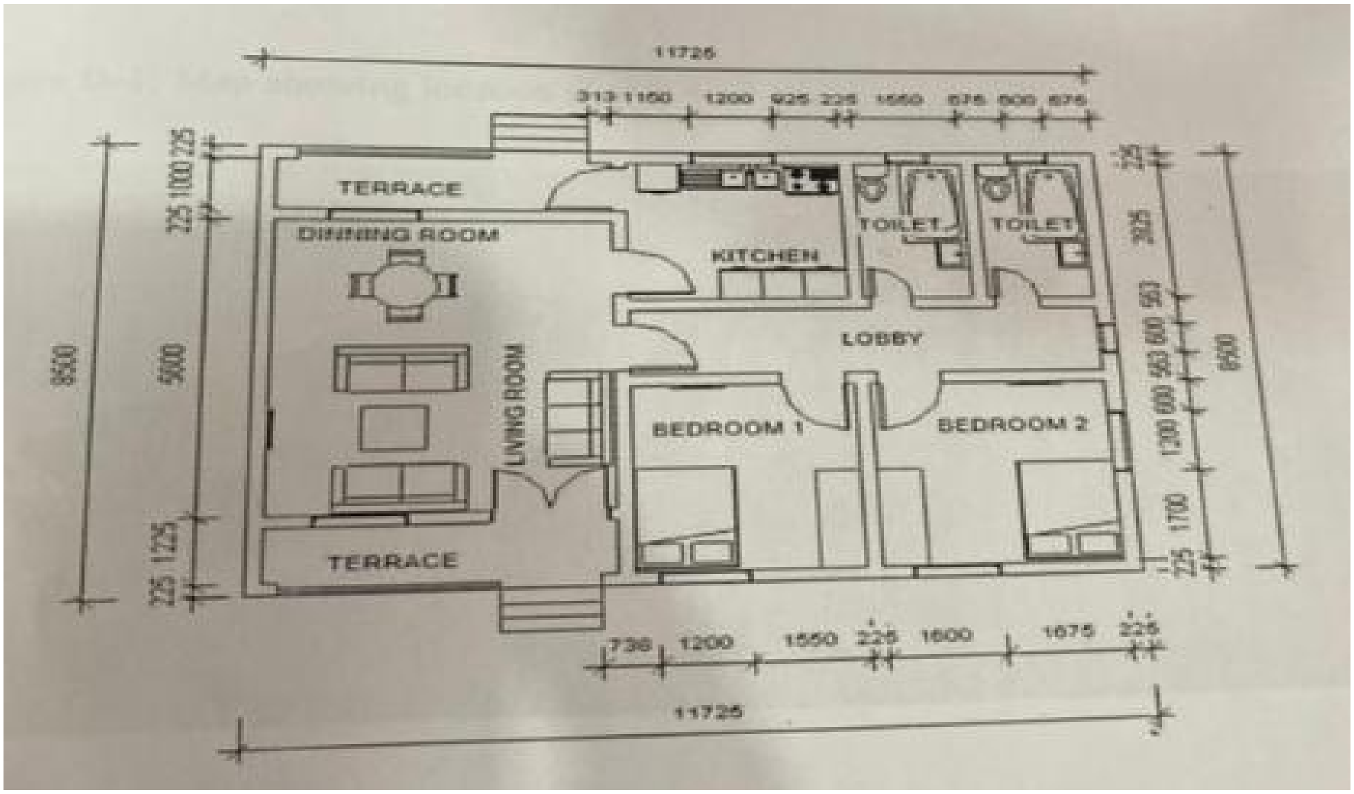

Figure C - 4: Building plan

CASE 4: Collapsed Building Site at Ekhator Street, off Edo Street, Ekosodin, Benin city, Edo State

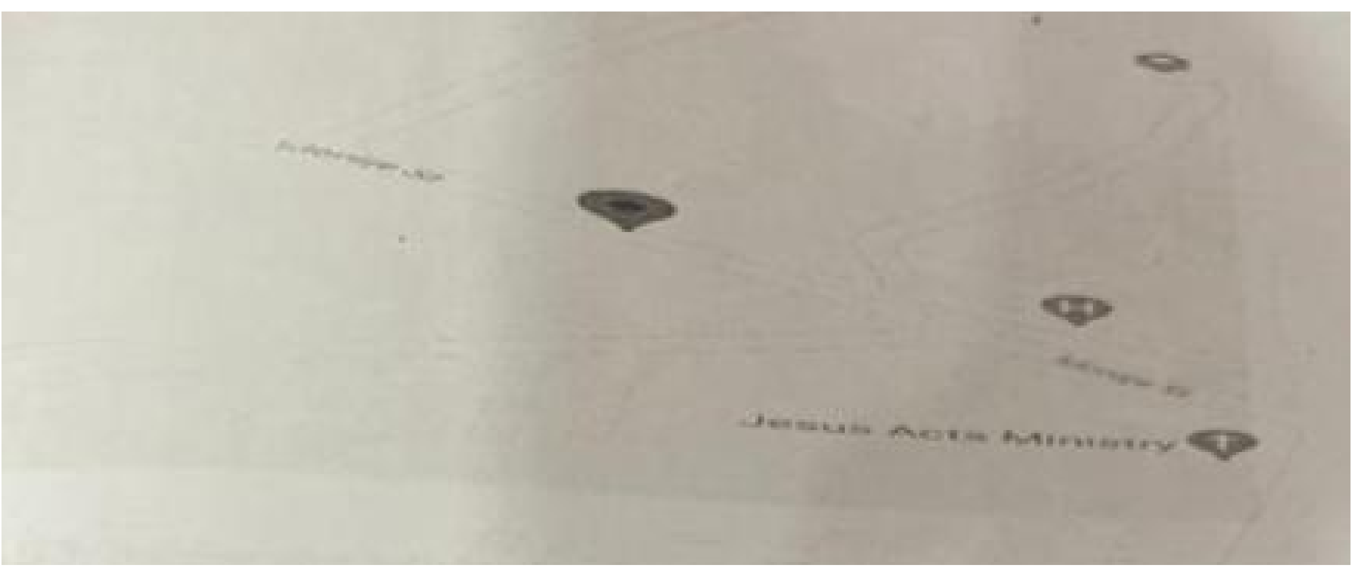

Figure D - 1: Map showing case 4


Plate D - 4: Building before collapse


Plate D - 3: Building after collapse

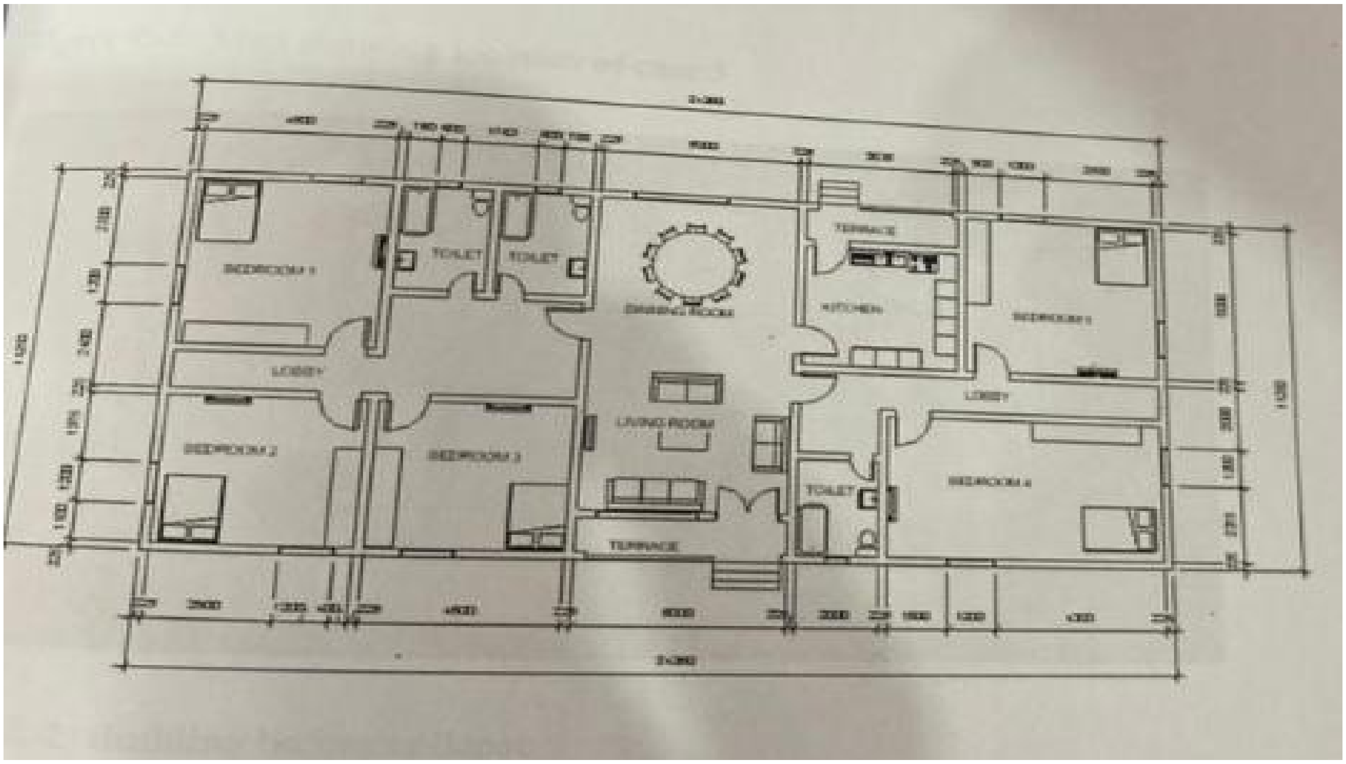

Figure D - 4: Building plan

CASE 5: Collapsed Building Site at 22, Egbeadokhai Street, Auchi, Edo State

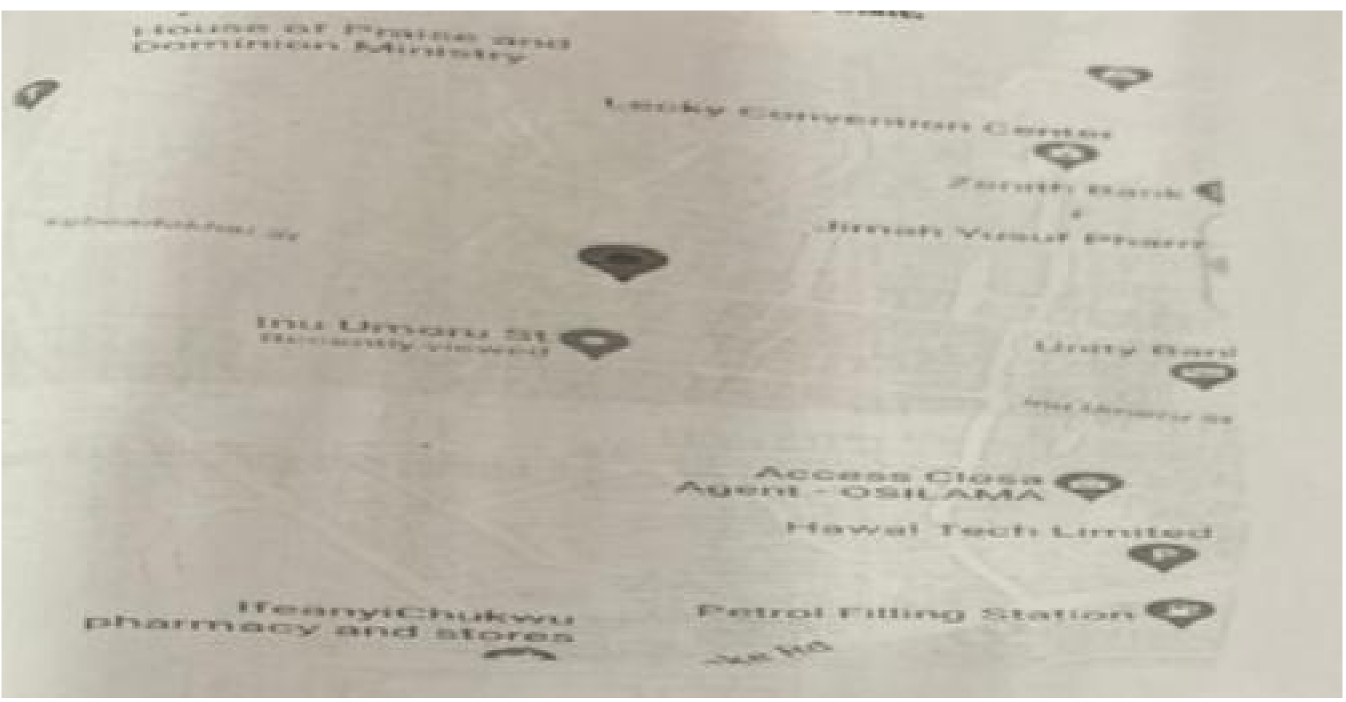

Figure E - 1: Map showing case 5

Plate E - 2: Building before collapse

Plate E- 3: Building after collapse

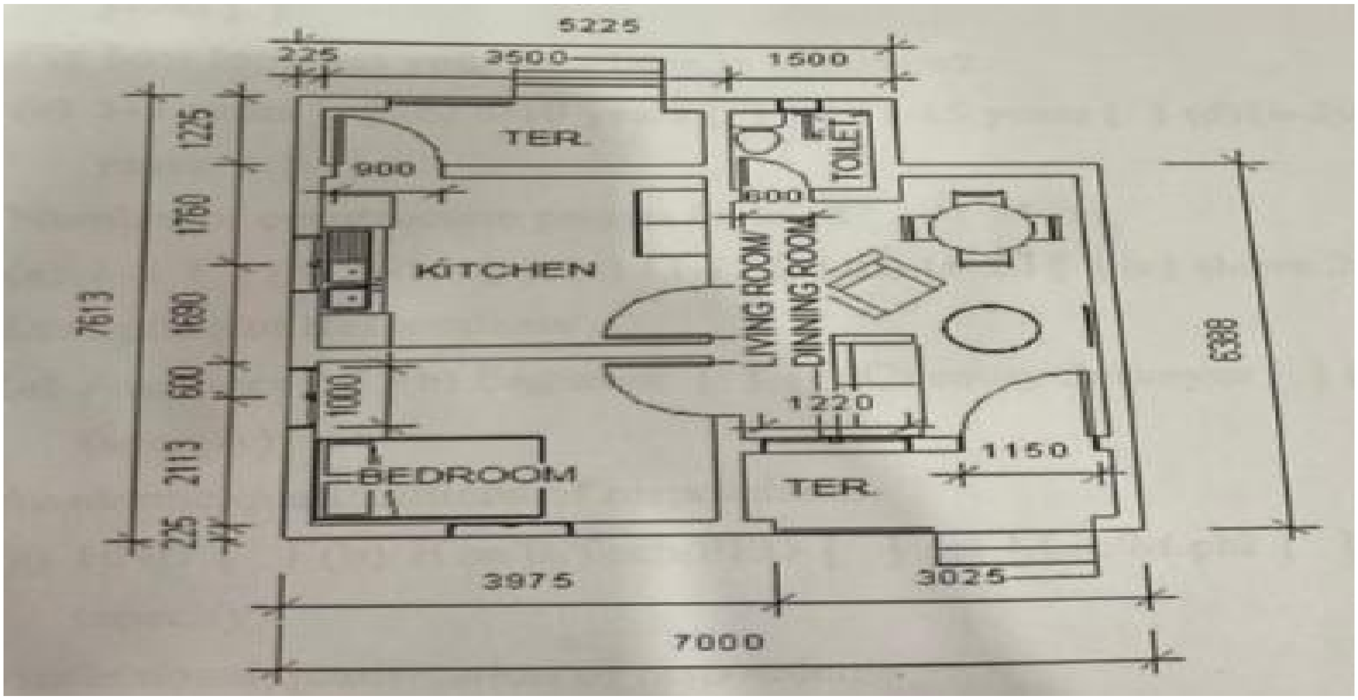

Figure E- 4: Building plan

FACULTY OF ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

UNIVERSITY OF BENIN, BENIN CITY, EDO STATE

DECLARATION

Dear respondent, I am a 500L civil engineering student of the University of Benin. As part of my degree, I am required to do a project research on Evaluation on the causes of building collapse in Edo state; A case study of Benin City. All responses given by you will be strictly kept confidential and used for academic purpose only.

Please read the questions correctly and give the correct answers to the question.

Section A: Demographic Information

1. Gender:

Male [ ] Female [ ]

2. Age:

18 - 25 [ ] 26 - 35 [ ] 36 - 45 [ ] 46 and above [ ]

3. Occupation:

Engineer [ ] Architect [ ] Builder [ ] Town planner [ ] Developer [ ]

Other (please specify):_________________

4. Educational Qualification:

SSCE [ ] OND/NCE [ ] HND/B.Sc [ ] M. Sc/Ph.D [ ]

5. Years of Experience in the Construction Industry:

Less than 5 years [ ] 5 - 10 years [ ] Above 10 years [ ]

6. Have you been involved in any construction project?

Yes [ ] No [ ]

7. Number of Construction project handled ?

(a) 1 - 5 years (b) 6 - 10 years (c) 11 - 15 years (d) Above 15 years

S/N	Identified Effects of Building Colllapse in Edo State Nigeria	Ranking				
		5	4	3	2	1
i	Loss of Lives					
ii	Destruction of Properties					
iii	Homelessness of Affected Persons					
iv	Insecurity to Affected Persons					
v	Loss of Huge Investments					
vi	Environmental Pollution					

8. The following have been identified as the measures to mitigate the occurrence of building collapse in Edo State Nigeria. Rank the identified measures in order of relevance using the scale below: 5 = very relevant; 4= relevant; 3= moderate; 2 = low and 1 = very low.

S/N	Identified Measures to Mitigate the Occurrence of Building Colllapse in Edo State Nigeria	Ranking				
		5	4	3	2	1
i	Regular Maintenance					
ii	Buildings must Conform to Specification					
iii	The Use of Quality Materials					
iv	Thorough Supervision					
v	Using Competent Professionals					
vi	Demolition of Buildings that Had gone Beyond repairs					
vii	Clients should be Sensitive of Quality Construction					
viii	The Building Regulations Should be adhere to					

SECTION B

Kindly rate on a scale of frequency, the frequency of building collapse in Edo State Nigeria.

1. Do building collapse occur frequently in Edo State? (a) Yes | 1 (b) No [1

2. Do you agree that building collapse have been a major concern in Nigeria and is a threat to human lives and properties in Edo State? (a) Yes [1 (b) No [1

3. The following have been identified as the causes of building collapse in Edo State Nigeria. Rank the various causes in order of severity using the scale below: 5 = very severe; 4= severe; 3= neutral; 2 = low and 1 = very low.

S/N	Identified Causes of Building Colllapse in Edo State Nigeria	Ranking				
		5	4	3	2	1
i	Unprofessional Condult					
ii	Poor implementation of Housing Policies					
iii	Faulty Design					
iv	Faculty Construction					
v	Use of Substandard Construction Materials					

vi	Lack of Maintenance					
vii	Employment of Incompetent Workmen					
viii	Ineffective Implementation of Building Regulations					
ix	Lack of Proper Soil Test					

4. The following have been identified as the effects of building collapse in Edo State Nigeria. Rank the various effects according to the order of severity using the scale below:

5 = very severe; 4= severe; 3= neutral; 2 - low and 1 = very lew.