Building Collapse in Abuja and Lagos Between 1984 and 2023: Assessing Structural Vulnerabilities to Prevent Reoccurrence

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Abstract

This study collects, collate, tabulate and analysed reported cases of structural failures leading to building collapses in Abuja and Lagos between 1984 and 2023. Four research questions and two null hypotheses were formulated to guide the study. The population of the study consisted of 417 Engineers comprising of 184 in Abuja and 233 in Lagos State chapter duly registered with the Nigerian Society of Engineers (NSE). The research employed purposive sampling technique to select 30 Civil Engineers from Abuja and Lagos State respectively. A 30-item questionnaire consisting of three sections and 5-point rating scale used for data collection was faced validated by three experts. Cronbach alpha statistics was used to determine the reliability coefficient of the instrument which yielded overall reliability index of 0.89 comprising of 0.91 and 0.87 for Section B and C respectively indicating that the instrument was reliable. Frequency, Percentage, Mean and standard deviation were used to answer research questions while the hypotheses were tested with independence t-test at 0.05 level of significance. Findings revealed that Abuja has 9 cases of building collapse and 114 numbers of lives lost while Lagos has 108 cases of building collapse and 460 numbers of lives lost. This implies that Lagos State has the highest numbers of building collapse and lives lost between 1984 and 2023. Furthermore, result of the study revealed that lack of monitoring, use of quacks and unapproved plan, inadequate site investigation and appropriate material tests among others were the causes of building collapse in Abuja and Lagos, Nigeria between 1984 and 2023. From the findings of the study, the researchers recommended that adequate monitoring of building construction, use of professionals and approved plan, adequate site investigation and appropriate material tests, prosecution of offender(s) among others as strategies to effectively mitigate incessant building collapses in Abuja and Lagos State, Nigeria between 1984 and 2023.

Keywords: *Building Collapse, Nigeria, Structural Failure, Causes, Remedy, Construction Industries.*

Introduction

Buildings serves as essential structures in civil engineering, designed and constructed using various forms and materials to provide accommodations such as residences, offices, schools, hospitals, and places of worship for people, their belongings, and their activities. These structures are valuable assets to humanity (Okosun, Abdulganiyu & Olagunju, 2017; Ogbemudia, Ndububa & Mbaezue, 2021). Regardless of whether they are temporary, permanent, or monumental, buildings require careful planning, construction, management, and maintenance to satisfy occupants, enhance the environment, and contribute to national development (Olagunju, Aremu & Ogundele, 2013; Babalola, 2015) and neglecting these aspects can lead to catastrophic collapses. In recent times, there has been increasing global concern over building collapses (Olubi & Adewolu, 2018; Ede, 2013). This issue affects various structures, including lattice towers, bridges, commercial buildings, water parks, embankment dams, balconies, hangars, and footbridges (Adebayo, 2020; Hilary, et. al, 2018). Building collapse refers to the partial or complete failure of components, compromising functionality, safety, and stability (Babalola, 2015). Building collapse occur when a building loses essential characteristics and strength, making it unable to support imposed loads adequately (Olubi & Adewolu, 2018). Building failures are generally categorized into physical or structural failures and performance-related failures (Olubi & Adewolu, 2018). Such failures can result in severe consequences, including harm to occupants, damage to property, and loss of lives (Ede, 2013).

Several studies (Adebayo, 2020; Okoye, et. al., 2023), have indicated that developing countries, such as Nigeria, have experienced a rise in building collapses due to factors like inadequate design, substandard materials, insufficient supervision, and non-compliance with standards. Government oversight issues have worsened the problem, with no state being immune to building collapse threats (Oyedele, 2018), which has caused significant economic losses and loss of life (Windapo & Rotimi, 2012; Okoye, et.al., 2023). Building collapses in Nigeria date back to 1974 with the collapse of a multi-storey building under construction in Mokola, Ibadan, which resulted in 27 fatalities (Olagunju, Aremu & Ogundele, 2013). This incident was the first documented building collapse in Nigeria post-independence. Since then, the issue has escalated, with frequent collapses occurring in cities such as Abuja, Lagos, Port Harcourt, Ibadan, Oyo, Kano, Osun, Akwa Ibom, and Ondo (Nicholas, Dickson & Okeke, 2022), which often occurred during construction (Yan & Kim, 2018). Numerous studies have investigated the causes and consequences of building collapses in Nigeria, pointing to factors such as poor structural design, use of substandard materials, lack of qualified professionals, and inadequate management and supervision (Olubi & Adewolu, 2018; Hilary, et.al., 2018; Almarwae, 2017; Nicholas, Dickson & Okeke, 2022). Additionally, researchers have identified incompetent contractors, faulty construction methods, non-compliance with standards, and the use of substandard materials as significant causes (Oloyede, Omoogun & Akinjare, 2010; Orikpete & Ewim, 2023). The inadequacies of empirical rules, including a lack of understanding of new construction technologies and structural complexities, have also been highlighted as contributing factors (Taiwo & Afolami, 2011; Hamma-adama, Iheukwumere & Kouider, 2020). Natural forces like flooding further contribute to building collapses (Oseghale, Ikpo, & Ajayi, 2015; Ogbemudia, Ndububa & Mbaezue, 2021).

The economic losses and safety concerns associated with these collapses are significant (Okeke, Sam-Amobi & Okeke, 2020). In Nigeria, the incidence of building collapse has claimed a total of 1455 lives reported in 175 occurrences from 1971 to 2016 (Omenihu, Onundi

& Alkali, 2016). In the same vein, the Nigeria Construction and Infrastructure Summit Group, stated that the country loses between 2.03 trillion and 3.05 trillion naira annually due to infrastructure deficits caused by building failures (Okeke, Sam-Amobi & Okeke, 2020). In major Nigerian cities like Abuja and Lagos, the phenomenon of building collapses has been a recurrent and tragic issue over the past decades highlighting critical vulnerabilities in the construction practices, and addressing this problem necessitates a thorough research. Hence, this study collects, collate and tabulate reported cases of structural failures leading to building collapses in Abuja and Lagos between 1984 and 2023. The study identified the underlying causes of structural failures and recommend strategies to prevent future reoccurrences.

Problem Statement

The recurring incidents of building collapses in Abuja and Lagos present a critical and persistent problem in construction practices within these major Nigerian cities, affecting developers, governments, consultants, landlords, and users. Despite various efforts to address the issue, collapses continue to occur with alarming frequency, leading to devastating consequences including loss of life, injuries, and significant economic losses. The causes of building collapses are complex and multifaceted. Various industry players, including clients, architects, engineers, town planners, and contractors, have been criticized for contributing to these failures. In response, some federal and state governments have enacted laws recommending the forfeiture of collapsed buildings and the prosecution of owners.

The research (Rayyan, 2019; Olasunkanmi, 2019), identified numerous factors responsible for building collapses, including faulty foundations, inadequate design briefs, design errors, poor-quality materials, subpar workmanship, poor maintenance, misuse and modification of buildings, improper supervision, owner-contractor issues, the use of non-professionals, excessively rushed construction, and the involvement of inexperienced professionals. Furthermore, corruption, bureaucratic inefficiencies, and a lack of accountability in building control agencies have exacerbated the problem, allowing unsafe structures to be erected and occupied (Job, et. al., 2019). The gap between policy and practice, alongside a general lack of public awareness about building safety standards, contributes to the persistence of this issue (Nwoyiri, Attado & Uchechi, 2023). This study aims to bridge gaps in previous research by collecting, organizing, and analyzing data on building collapses in Abuja and Lagos, identifying the root causes of structural failures, and recommend effective mitigation strategies.

Purpose of the Study

The purpose of the study was to:

1. Compile and tabulate cases of building collapse due to structural failures between 1984 and 2023 in Abuja and Lagos, Nigeria.
2. Determine the frequency of building collapse and casualties due to structural failures in Nigeria between 1984 and 2023.
3. Determine the causes of structural failure that result in building collapse in Nigeria.
4. Propose effective strategies to mitigate the causes of structural failures resulting in building collapses in Nigeria.

Research Question

Four research questions guided the study:

1. What are the cases of building collapse due to structural failures between 1984 and 2023 in Abuja and Lagos, Nigeria?
2. What is the frequency of building collapses and casualties due to structural failures in Nigeria between 1984 and 2023?
3. What are the causes of structural failures that lead to building collapses in Nigeria between 1984 and 2023?
4. What are the strategies that can effectively mitigate the causes of structural failures that lead to building collapses in Nigeria?

Null Hypotheses

The research tests the following null hypotheses:

HO_1 - There is no statistically significant difference in the mean responses of Civil Engineers in Abuja and Lagos on the cases of structural failures that result in building collapses in Nigeria between 1984 and 2023.

HO_2 - There is no statistically significant difference in the mean responses of Civil Engineers in Abuja and Lagos on strategies to mitigate the causes of structural failures that result in building collapses in Nigeria between 1984 and 2023.

Review of Related Literature

A thorough review of literature indicates that between 1974 and 2022, spanning 48 years, Nigeria has experienced numerous building collapses in its major towns and cities, resulting in many fatalities and various degrees of injuries (Okeke, Chendo & Sam-amobi, 2019). In a study conducted by Emekoma, Weli and Umeuduji (2023) aimed at evaluating remedial measures and the trend of building collapses in Nigeria addressed several aspects, including identifying solutions for building collapses, analyzing the trend of such incidents from 1974 to 2021, and assessing the spatial distribution of collapse incidents across southern Nigeria. The study used both primary and secondary data sources and employed a stratified random sampling method for sample selection. Data analysis was conducted using descriptive and inferential statistics, and geospatial techniques were utilized to create spatial variation maps of building collapses. The findings revealed that cities like Cross River, Akwa Ibom, Ekiti, Ebonyi, and Bayelsa State had the lowest incidence of building collapses, while Lagos had the highest. However, the frequency of building collapses across the states showed no significant variation.

Another study conducted by Okoyea, Apeha, Olayea and Osujib, (2023), focused on automating the tracking of building integrity and reviewing building collapses in Nigeria provided an updated record of the impacts from 1973 to 2022. The research analyzed casualties by decade, the heights of affected structures, and specific locations of collapses. The dataset was compiled from a variety of sources, including journal articles, academic reports, newspapers, and conference proceedings. Analysis was conducted using MATLAB and Excel, along with GPS data. The findings reported a total of 177 recorded building collapses during this period, resulting in the loss of over 956 lives. Additionally, Ogbemudia, Ndububa and Mbaezue (2021) examined the causes of building collapse in Abuja, Nigeria, used primary and secondary data to identify the causes and assess the actions taken by authorities. Statistical analysis revealed that substandard materials (53.09%) and poor workmanship (17.28%) were

the main causes, along with flawed design and deviations from approved plans. The study recommended that the government enact laws to prevent the use of substandard materials.

An evaluation of the causes and consequences of building collapses in Nigeria, spanning from 1974 to 2009, was conducted using diverse sources such as books, seminar papers, workshop papers, and articles. The analysis utilized tables, percentiles, Pearson correlation coefficient (r), and linear regression to construct a model. The study identified poor maintenance practices, design errors, low-quality materials and workmanship, natural disasters, and excessive loading as contributors to building collapses, with percentages of 7%, 13%, 53%, 7%, and 20% respectively. The majority of collapses involved private residential buildings constructed by local contractors. Recommendations included strengthening the efforts of the Standard Organization of Nigeria in regulating building materials and increasing supervision by professional bodies within the construction industry (Oguntimehin, & Adejugbagbe, 2019).

In another study by Hamma-Adama and Kouider (2017) on the causes of building failures and collapses in Nigeria was assessed from the perspective of construction professionals. Primary data were gathered through questionnaire surveys distributed to construction consultants, contractors, and clients. Out of 150 structured questionnaires distributed randomly, 99 were successfully retrieved for analysis. Simple statistical methods and charts were used to analyze the 99 questionnaires. The findings indicated a disturbing frequency of building collapses in Nigeria, attributed to factors such as substandard reinforcement, structural steel, and cement used in the production of foundations, columns, beams, and slabs. These issues were often linked to deficiencies in construction supervision, highlighted with a Relative Importance Index (RII) of 0.812 (ranked 1st), followed by shortcomings in the construction process with an RII of 0.709.

Another study conducted by Ehiorobo and Okovido (2013), examined the structural integrity of a school building at risk in Benin City, Nigeria, using geotechnical measurement parameters. The investigation included visual inspections, soil analysis, and Dutch Cone Penetrometer Tests. The findings revealed that foundation-related issues, particularly differential settlement, were contributing factors to the observed structural problems. The study observed that isolated foundation footings were experiencing significant bearing pressure in consolidating soil, leading to considerable differential settlement. To address these issues, recommendations were put forward for implementing a raft foundation slab. Despite these valuable studies, there remains a noticeable gap in the assessment of building collapses due to structural failures in Abuja and Lagos, which have had devastating impacts on lives and properties between 1984 and 2023 (Olasunkanmi, 2019; Rayyan, 2019). While previous studies in Nigeria have provided direction on evaluating remedial measures and the trend of building collapses and automating the tracking of building integrity with different trajectories (Hamma-Adama & Kouider, 2017; Oguntimehin, & Adejugbagbe, 2019; Emekoma, Weli & Umeuduji, 2023; Okoyea, et al., 2023), the present study collects, collate, tabulate and analyzed reported cases of structural failures leading to building collapses in Abuja and Lagos between 1984 and 2023.

Methodology

This section outlined the research framework, including the design of the study, geographical scope, population, instrument validation, data collection, analysis methods, and

decision criteria for reviewing building collapse due to structural failure in Abuja and Lagos between 1984 and 2023.

Area of the Study

The research was conducted in Nigeria, a West African nation characterized by diverse geography, with climates ranging from arid to humid equatorial (Okeke, Sam-Amobi & Okeke, 2020). Spanning 923,768 sq km, with a population exceeding 200 million, residing within its six geopolitical zones. Positioned between latitudes 4°N and 14°N and longitudes 3°E and 14°E, Nigeria shares boundaries with the Atlantic Ocean, Sahara Desert, and Cameroon Mountains, which form the southern, northern and eastern boundaries respectively. However, this study focused exclusively on Abuja and Lagos State.

Design of the Study

A descriptive survey research design was adopted for the study. This approach collects and systematically describes data concerning specific traits of a given population (Nworgu, 2015).

Population and Sampling Techniques

The population of the study consisted of 417 Engineers comprising of 184 in Abuja and 233 in Lagos State chapter duly registered with the Nigerian Society of Engineers (NSE). The research employed purposive sampling technique to select 30 Civil Engineers from Abuja and Lagos State respectively. Sample is seen as a portion of the population to be studied that is carefully selected to represent all the characteristic traits of the larger population to make valid generalized statements about the population (Nworgu, 2015).

Data Sources

The paper explored scholarly primary and secondary sources on building collapse due to structural failure in Abuja and Lagos between 1984 and 2023. The primary data were obtained using a structured questionnaire administered to 30 Civil Engineers (CE) in Abuja and 30 Civil Engineers (CE) in Lagos State. Secondary data were obtained from existing or published articles on internet, journals and documented reports on building collapse.

Data Collection Instrument

The instrument use for data collection was a structured questionnaire titled: Building Collapse due to Structural Failure (BCSF). The questionnaire has section A which contains the respondents' demographic data. Section B and C contained fifteen (15) items each on causes and measures to mitigate structural failure. The instrument was face validated by three experts from the Department of Civil Engineering, University of Nigeria, Nsukka, Anambra State. The experts after examining the instrument, made some corrections which were effected from the experts opinion.

Reliability of Instrument

In order to ensure the internal consistency of the instrument, ten registered Civil Engineers (CE) who were not part of the study were trial tested in Lagos State. Cronbach alpha statistics was used to determine the reliability coefficient of the instrument which yielded

overall reliability index of 0.89 comprising of 0.91 and 0.87 for Section B and C respectively. The reliability co-efficient values were considered appropriate for the study.

Method of Data Analysis

The researchers administered the instrument directly to the respondents in their offices and construction sites with the help of three research assistants who were instructed on what was required. The instrument was collected immediately after completion, achieving a 100% return rate. Data collected through the questionnaire was analyzed using mean and standard deviation. A 5-point rating scale of Strongly Agreed (SA), Moderately Agreed (MA), Lowly Agreed (LA), Not Agreed (NA) and Undecided (U) was used as checklist for the responses. The cut-off points for the interpretation of the mean of the respondents' opinion were: SA = 4.50-5.00, MA = 3.50-4.49, LA=2.50 - 3.49, NA=1.50 - 2.49 and U=1.00-1.49 respectively. Independent t-test was used to test the null hypotheses at .05 level of significance. Where the calculated t-value was greater than the tabulated value, null hypothesis was rejected, where the calculated t-value was less than the tabulated value null hypothesis was upheld.

Presentation of Results and Discussion

Research Question 1: What are the cases of building collapse due to structural failures between 1984 and 2023 in Abuja and Lagos, Nigeria?

Table 1: *Cases of building collapse due to structural failures between 1984 and 2023 in Abuja and Lagos, Nigeria.*

S/N	STATE/ REFERENCES	YEAR OF COLLAPSE	TYPE OF BUILDING	LOCATION	CASUALTY	CAUSES OF COLLAPSE
A.	**ABUJA, FCT**					
1.	(Olabosipo & Adedamola, 2010)	March, 1993	Multi-purpose Indoor Sports Complex Storey	Area 10, Abuja	Not Reported	Structural Failure /Poor Workmanship
2.	(Olabosipo & Adedamola, 2010)	Mar. 25, 1993	Multi-storey Building, NICON-NOGA Staff Housing Project	Karo, Abuja	Not Reported	Structural Failure/Use of Incompetent Supervision
3.	(Olabosipo & Adedamola, 2010)	1998	Duplex Building	Gwarinpa Area, FCT, Abuja	2 Died	Structural Failure
4.	(Taiwo & Afolami, 2011)	Aug. 2, 2008	5-Storey Shopping Complex Building Under construction	Wuse Area, Abuja	2 People Injured and 100 People Trapped	Structural Failure, Incompetency/Bad Workmanship
5.	(Omenihu, Onundi & Alkali, 2016)	Nov., 2009	2-Storey Commercial Building	Garki Abuja	-	Structural Failure Substandard Material
6.	(Chendo & Obi, 2015)	June 2011	2 Storey Building	Nyanya, Abuja	4 Died	Large Span Slab
7.	(Omenihu, Onundi & Alkali, 2016)	Jan. 28, 2012	2 Storey Building	Gwarinpa Estate Abuja	3 Died	Structural Defect
8.	(Babalola, 2015)	August 8, 2012	2-Storey Building under construction	No 3 Ademola Awosike Road Kubwa Extension III, Abuja	3 Died 9 Injured	Structural Failure
9.	(Awe, et al., 2023)	Feb. 2, 2023	4-Storey Building Under Construction	4th Avenue, Gwarimpa Estate, Abuja	2 Died	Structural Failure
B	**LAGOS STATE**					
1.	(Fakere, Fadairo & Fakere, 2012)	1983	4-Storey Building	Lewis St. Island Lagos	Not Reported	Structural Failure
2.	(Ebehikhalu & Dawam, 2014)	Sept. 1983	2-Storey Building	Iponri, Lagos	8	Structural Failure
3.	(Oke, 2011)	1983	2-Storey Building	Oju-elegba Road, Lagos	Not Reported	Structural Failure
4.	(Oni, 2010)	1984	2-Storey Building	Beecroft Street, Lagos	Not Reported	Structural Failure
5.	(Ebehikhalu & Dawam, 2014)	Jan., 1985	4 Storey Uncompleted Building	Allen Avenue, Ikeja, Lagos	Nil	Excessive Loading, Structural Defects

6.	(Olabosipo & Adedamola, 2010)	May 20, 1985	Residential Building (Uncompleted 4 Storey Building)	Western Avenue Iponri, Lagos	13 Died	Structural Failure, Excessive Loading
7.	(Oni, 2010)	July 18, 1985	2 Storey Residential Building	Victoria Island, Lagos	13 Died (all of the Same family)	Excessive Loading, Structural Defects
8.	Olabosipo & Adedamola (2010)	1985	3 Storey Building	Adeniji Adele, Lagos	2 Died	Faulty Design, Structural Defects
9.	Olabosipo & Adedamola (2010)	May 9, 1987	2 Storey Building under Construction	Agege, Lagos	2 Died	Structural Failure
10.	(Oni, 2010)	1987	2 Storey Building	Akinade Village, Ikeja, Lagos	Not Reported	Structural Failure
11.	(Fakere, Fadairo & Fakere, 2012)	1987	3 Storey Building	Idumagbo Area, Lagos	Not Reported	Structural Failure
12.	(Olabosipo & Adedamola, 2010)	Sept. 14, 1987	4 Storey Building	20, Idusagbe Lane, Idumota Lagos	17 Died	No Structural Design
13.	(Oke, 2011)	Sept., 1987	3 Storey Building	Ikorodu Road, Lagos	4 Died	Rainstorm, Structural Failure
14.	(Oke, 2011), (Chendo & Obi, 2015)	1989	6 Storey Royal Hotel	Idumota, Lagos Island	Not Reported	Structural Failure
15.	(Ebehikhalu & Dawam, 2014)	1989	School Building	Beecroft Lane, Lagos Island	Not Reported	Structural Failure
16.	(Chendo & Obi, 2015)	1990	3 Storey Uncompleted Building	Idi-Oro, Mushin Lagos	Not Reported	Structural Failure
17.	(Chendo & Obi, 2015)	1990	4 Storey Office Block	Idumagbo, Lagos, Island	Not Reported	Structural Failure
18.	(Ebehikhalu & Dawam, 2014)	1990	3 Storey Uncompleted Building	Idumota, Lagos Island	Not Reported	Structural Failure
19.	(Babalola, 2015)	1991	3 Storey Building	Moyosore Close, Gbagada, Somolu Lagos	Not Reported	Structural Failure
20.	(Ebehikhalu & Dawam, 2014)	1991	Lecture Hall,	Unilag, Faculty of Education, Akoka, Lagos	Not Reported	Structural Failure
21.	(Babalola, 2015)	August, 1991	2 Storey Building	Lagos	10 Died	Structural Defect
22.	(Babalola, 2015)	1992	2-Storey Building	Hawley Road, Sabo, Yaba Lagos	Not Reported	Structural Failure
23.	(Chendo & Obi, 2015)	1992	2 Storey Building	Oyadiran Estate, Yaba Lagos	Not Reported	Structural Failure
24.	(Ebehikhalu & Dawam, 2014)	June, 1992	Hotel Building	Lagos	2 Died, Several Injured	Defective Structural Design
25.	(Olabosipo & Adedamola, 2010)	1993	6-storey Hotel Complex	Okupe Estate Maryland, Lagos	Not Known	Structural Failure
26.	(Oni, 2010)	1993	Block of 4 No. Flats	Adeniyi Close, Bariga Lagos	Not Reported	Structural Failure
27.	(Fakere, Fadairo & Fakere, 2012)	1994	Hotel Building	Okesuna Road, Lagos Island	Not Reported	Structural Failure
28.	(Ebehikhalu & Dawam, 2014)	1994	3 Storey Uncompleted Building	Idumagbo Area, Lagos Island	Not Reported	Structural Failure
29.	(Oke, 2011)	1994	Estate Building	Ajah, Etiosa Lagos	Not Reported	Structural Failure
30.	(Babalola, 2015)	1994	3 Storey Building	Airport Road, Oshodi Lagos	Not Reported	Structural Failure
31.	(Olabosipo & Adedamola, 2010)	Oct., 5,1995	Storey Building (Under Construction)	Central Lagos	10 Died	Poor Workmanship/ Structural Failure
32.	(Olabosipo & Adedamola, 2010)	Oct., 30, 1995	3 Storey Church Building	Lagos	6 Died	Structural Failure
33.	(Chendo & Obi, 2015)	1995	2 Storey Uncompleted Building	Iponri, Lagos	Not Reported	Structural Failure
34.	(Oni, 2010)	1995	3 Storey Building	Agege, Lagos	Not Reported	Structural Failure
35.	(Ebehikhalu & Dawam, 2014)	1995	2 Storey Building	Agege, Lagos	Not Reported	Structural Failure
36.	(Babalola, 2015)	1995	3 Storey Uncompleted Office Block	Maryland, Ikeja Lagos	Not Reported	Structural Failure

37.	(Oke, 2011)	1995	6 Storey Uncompleted Building	Wale Ajose St, Mende, Lagos	Not Reported	Structural Failure
38.	(Babalola, 2015)	Jan., 1995	6 Storey Classroom Building Under Construction	Maryland Ikorodu Road, Lagos	1	Structural Defects, Substandard Materials
39.	(Olabosipo & Adedamola, 2010)	June, 1996	2 Storey Building under construction	Olowookere Street, Mafoluku, Oshodi, Lagos	7 Died	Structural Weakness
40.	(Olabosipo & Adedamola, 2010)	Mar., 13, 1996	Storey Building under Construction	Lagos State	Injuries Only	Structural Weakness
41.	(Olabosipo & Adedamola, 2010)	October, 1996	6-Storey Building Under Construction (Being Used as Nursery/Primary School)	Ijagbemi Street, Pedro Lagos	1 Died	Use of Quacks/ Structural Failure
42.	(Chendo & Obi, 2015)	June, 1997	2-Storey Building	Amu Street, Mushin, Lagos	Nil	Use of Poor Materials/ Structural Failure
43.	(Oke, 2011)	1998	Church Building Under Construction	Mafoluku, Oshodi, Lagos	Not Reported	Structural Failure
44.	(Babalola, 2015)	1998	3 Storey Uncompleted Building	Igbobi, Somolu, Lagos	Not Reported	Structural Failure
45.	(Oke, 2011)	1999	3 Storey Uncompleted Building	Idumota Area, Lagos Island	Not Reported	Structural Failure
46.	(Chendo & Obi, 2015)	1999	Eleganza Building	Ikota, Ajah, Lagos	Not Reported	Structural Failure
47.	(Oke, 2011)	1999	2-Storey Building	Idusagbe Lane, Lagos Island	Not Reported	Structural Failure
48.	(Babalola, 2015)	1999	3-Storey Building	Oke– Igbala, Mushin Lagos	Not Reported	Structural Failure
49.	(Chendo & Obi, 2015)	1999	Church Building	Olowookere, Oshodi, Lagos	Not Reported	Structural Failure
50.	(Oke, 2011)	June, 1999	3-Storey Residential Building	Charity Road, Oko-Oba, Lagos	Not Reported	Structural Failure
51.	(Olabosipo & Adedamola, 2010)	August, 1999	3-Storey Residential Building	Iju-Isaga, Lagos	35 Died	Structural Failure / Rainstorm
52.	(Olabosipo & Adedamola, 2010)	October, 1999	1-Storey Residential Building	Obawole Street, Iju,, Agege, Lagos	Nil	Structural Failure
53.	(Chendo & Obi, 2015)	2000	Church Building	3/13 Thomas Drive, Bariga Lagos	120 Injured and 3 Died	Structural defects
54.	(Taiwo & Afolami, 2011)	April, 2000	Estate Building	Ajah, Along Lekki, Road, Lagos	Nil	Structural Failure
55.	(Babalola, 2015)	2000	4-Storey Building	10-12, Suene Street, Surulere, Lagos	2 Died	Structural Failure
56.	(Babalola, 2015)	2000	Primary School Building	Atunrase Street, Surulere Lagos	Not Reported	Structural Failure
57.	(Michael & Oyewale, 2018)	2000	Eleganza Building,	Ikota Ajah, Lagos	25 Died Injured ,2	Structural Failure
58.	(Michael & Oyewale, 2018)	2000	St., Dennis, Catholic Church	Bariga, Lagos	3 Died	Structural Failure
59.	(Oke, 2011)	2001	3-Storey uncompleted building	Igbosere Street, Lagos Island	Not Reported	Structural Failure
60.	(Babalola, 2015)	2001	4-Storey uncompleted building	Idusagbe Lane, Lagos Island	Not Reported	Structural Failure
61.	(Michael & Oyewale, 2018)	2001	Karunwi, Central Mosque	Mushin, Lagos	7 Died	Structural Failure
62.	[23], [48]	2002	2-Storey Building	Agege Road, Lagos	Not Reported	Structural Failure
63.	(Michael & Oyewale, 2018)	2002	3-Storey Building	Allen Avenue, Ikeja, Lagos	Not Reported	Structural Failure
64.	(Babalola, 2015)	2002	3-Storey Building	10 Jones Street, Ebute Metta West Lagos	Not Reported	Dilapidation. Structural Defects
65.	(Chendo & Obi, 2015)	2002	49 Olonode Street, Yaba, Lagos	2-Storey Building	Not Reported	Structural Failure
66.	(Ebehikhalu & Dawam, 2014)	2003	1-Storey Building	50 Willoughby Street Ebute Meta, Lagos	8 Injured	Structural Failure
67.	(Babalola, 2015)	2003	4-Storey Uncompleted Building	Adeniji Adele Road, Lagos	Not Reported	Structural Failure
68.	(Ebehikhalu & Dawam, 2014)	2003	3-Storey Uncompleted Building	Bereka Lane, Lagos	Not Reported	Structural Failure

69.	(Babalola, 2015)	2004	3-Storey Building	22, Markurdi Street, Ebute Metta, Lagos	Not Reported	Structural Failure
70.	(Fakere, Fadairo & Fakere, 2012)	2005	2-Storey Building	Anthony Way, Lagos	Not Reported	Structural Failure
71.	(Oni, 2010)	2005	3-Storey Uncompleted Building	Adenijiadele, Lagos Island	Not Reported	Structural Failure
72.	(Babalola, 2015)	2005	2-Storey Building	40, Market Street, Shomolu, Lagos	Not Reported	Structural Failure
73.	(Fakere, Fadairo & Fakere, 2012)	2005	2-Storey Uncompleted Building	Mende, Maryland, Ikeja Lagos	Not Reported	Structural Failure
74.	(Ebehikhalu & Dawam, 2014)	2006	4-Storey Building	53, Cemetery Road, Amukoko, Lagos	Not Reported	Structural Failure
75.	(Babalola, 2015)	2006	3-Storey Building	Ijora, Ajegunle Lagos	Not Reported	Structural Failure
76.	(Fakere, Fadairo & Fakere, 2012)	2006	2-Storey Building	1, Murtala Muhammed Airport Road Oshodi, Lagos	Not Reported	Structural Failure
77.	(Oke, 2011)	2006	3-Storey Building	42, Ibadan Street, Ebuta meta, Lagos	Not Reported	Structural Failure
78.	(Oni, 2010)	2007	2-Storey Building	118, Ojuelegba Road, Surulere, Lagos	37 Died	Structural Failure
79.	(Babalola, 2015)	2007	2-Storey Building	8 Ashaka Street, Abulenla Ebute Metta, Lagos	Not Reported	Structural Failure
80.	(Ajufoh, Gumau, & Inusa, 2014)	2007	3-Storey Building	71 Agoro Street, Lagos	Not Reported	Structural Failure
81.	(Windapo & Rotimi, 2012)	2007	4-Storey Building	32B Egerton Lane, Oke Arin, Lagos	Not Reported	Structural Failure
82.	(Ajufoh, Gumau, & Inusa, 2014)	2007	3-Storey Building	38, Idumagbo Avenue, Island	Not Reported	Structural Failure
83.	(Nwankwo, Nwankwo & Okafor, 2015)	2007	3-Storey Building	48, Adams Street, Lagos	Not Reported	Structural Failure
84.	(Ebehikhalu & Dawam, 2014)	2007	2-Storey Building	Lasu-iba Road, Opposite Rosellas, Lagos	Not Reported	Structural Failure
85.	(Fakere, Fadairo & Fakere, 2012)	2008	Residential Building	Apongbon Lagos	3 Died	Structural Failure
86.	(Fakere, Fadairo & Fakere, 2012)	2008	Residential Building	Alade Street Lagos	3 Died, 5 Injured	Structural Failure
87.	(Clement, 2013)	Sept.28, 2010	4 Storey Uncompleted Building	24 Alli Street, Off Tinubu Street, Victoria Island, Lagos	Several People Died, Injured 3	Structural Defects/ Overloading
88.	(Windapo & Rotimi, 2012)	Oct., 2011	A Penthouse	Aderibigbe Street, Maryland Lagos	2 Died	Structural Failure
89.	(Babalola, 2015)	Nov. 4, 2012	Building under Construction	Muri Okunola Street Eti-Osa LGA of Victoria Island Lagos	3 Died 50 Trapped	Structural Failure/ Poor Construction
90.	(Omenihu, Onundi & Alkali, 2016)	Nov. 20, 2012	Building (In-use)	Jakande Estate in Oke-Ake-Afa, Isolo Lagos	3 Died	Structural Failure
91.	(Babalola, 2015)	Nov. 20, 2012	Residential Building	!74 Corporation Drive Dolphin Estate, Ikoyi Lagos	Not Reported	Structural Failure
92.	(Clement, 2013)	May 8, 2013	2-Storey Building under construction	Ojodu, Lagos	1 Died	Structural Failure
93.	(Oyegbile, Tat, & Olutoge, 2016)	July 11, 2013	Residential Building	Ebeute-Meta, Lagos	7 Died	Structural Failure
94.	(Awoyera, et al., 2021)	July 30, 2014	3 Storey Building	Bucknor Estate, Jakande-Isherioshun Road. Ejigbo/ Isolo Lagos State	Not Reported	Structural Failure
95.	(Oyegbile, Tat, & Olutoge, 2016)	Sept. 12, 2014	Synagogue Church of All Nations (SCOAN)	Ikotun Area, Lagos	116 Died, 100 Injured	Structural Failure/ Design/Detailing Error

96.	(Odeyemi, Giwa & Abdulwahab, 2019)	July 15, 2015	3-Storey Residential Building	Ebute Meta Lagos	4 Rescued	Structural Failure
97.	(Oloke, et al., 2017)	Oct. 21, 2015	3-storey Residential Building	Swamp Street Odunfa Lagos Island	Not Reported	Structural Failure
98.	(Michael & Oyewale, 2018)	Mar. 09, 2016	5 Storey Building under Construction	Lekki Phase 1, Lagos	34 Died	Structural Failure
99.	(Obodoh, Nwachukwu & Obodoh, 2019)	Mar. 19, 2016	2 Storey Building	Mile 12, Lagos	1 Died 1 Injured	Structural Defects
100.	(Odeyemi, Giwa & Abdulwahab, 2019)	April, 2016	Residential Building	Horizon 1, Lekki Garden, Ikate	18 Died	Structural Failure
101.	(Obodoh, Nwachukwu & Obodoh, 2019)	2016	Residential Building	Police Baracks, Ikeja Lagos	2 Died	Structural Failure/ Lack of Maintenance
102.	(Ede, 2013)	2017	3 Storey Mixed Building	9 Dada Alaja Steet, Oke-Arin, Idumota, Lagos	2 Died, 14 Injured	Structural Failure/ Illegal Repair
103.	(Awe, et al., 2023)	Nov. 1, 2021	21 Storey Building	Along Gerrard Road, Ikoyi, Lagos	52 Died	Structural Defect Caused by Overloading
104.	(Ayayi, 2022)	May 7, 2022	2 Storey Building	Chris Igade Street, Off Ago Palace Wary, Opposite Kilamajaro/AP, Lagos State	No Casualty was Recorded	Structural Failure
105.	(Ayayi, 2022)	May 21, 2022	2 Storey Building	Freeman Street, Lagos Island, Lagos	1 Died	Heavy Rainfall/ Structural failure
106.	(Awe, et al., 2023)	Sept. 4, 2022	9-Storey Building Under Construction	Oniru Estate, Victoria Island, Lagos State	4 Died	Structural Failure
107.	(Maduka, 2023)	April 12, 2023	7-Storey Building under construction	First Avenue, Banana Island, Ikoyi Area, Lagos State	Not Reported	Structural Failure
108.	(Akoni, 2023)	April 23, 2023	3-Storey Building under construction	45 Ladipo Oluwo Street, GRA, Apapa, Lagos.	No Casualty was Recorded	Thunder Strike/ Structural Failure

The data presented in Table 1 shows revealed 9 and 108 reported structural failure cases in Abuja and Lagos State respectively, causes and characteristics which include number of floors, usage of the building, location of the building, year of building collapse and casualties/fatalities of collapsed buildings between 1984 and 2023.

Research Question 2: What is the frequency of building collapses and casualties due to structural failures in Nigeria between 1984 and 2023?

Table 2: *Frequency of building collapse and casualties due to structural failures in Nigeria between 1984 and 2023.*

S/N	YEARS	ABUJA			LAGOS		
		Freq.	% Freq.	No. of Lives Lost	Freq.	% Freq.	No. of Lives Lost
1.	1984-1993	2	22.2	NIL	26	24.1	61
2.	1994-2003	1	11.1	2	42	38.9	110
3.	2004-2013	5	55.6	110	25	23.1	59
4.	2014-2023	1	11.1	2	15	13.9	230
	Total	**9**	**100**	**114**	**108**	**100**	**460**

Note: Freq. = Frequency

The data presented in Table 2 show frequency and percentage of reported cases of building collapse and numbers of lives lost in Abuja and Lagos between 1984 and 2023. The reports revealed that Abuja has 9 cases of building collapse and 114 numbers of lives lost while Lagos has 108 cases of building collapse and 460 numbers of lives lost. This implies that Lagos State has the highest numbers of building collapse and lives lost between 1984 and 2023. This

implies that Lagos State has the highest numbers of building collapse and lives lost between 1984 and 2023.

Research Question 3: What are the causes of structural failures that lead to building collapses in Abuja and Lagos between 1984 and 2023?

Table 3: *Causes of structural failure that led to building collapses in Nigeria between 1984 and 2023.*

S/N	Section A: Causes of Structural Failure	CE in ABUJA		CE in LAGOS		DEC.
		X	SD	X	SD	
1.	Lack of monitoring of building construction for effective compliance to Nigeria's building code and regulations.	4.61	1.18	4.53	1.13	SA
2.	Patronizing quacks and using unapproved design to carry out construction and supervision of building projects.	4.83	1.35	4.59	1.19	SA
3.	Inadequate site investigation and appropriate material tests before carrying out any building construction.	4.57	2.11	4.50	0.81	SA
4.	Lack of prosecution of offender(s) who carryout building construction without complying with Nigeria's building code and regulations.	4.70	1.17	4.74	0.97	SA
5.	Inadequate assessment and demolitions of buildings that have exceeded Development Control.	4.58	2.06	4.53	1.42	SA
6.	Inadequate auditing of buildings stability in order to avert the collapse of distressed buildings as well as publishing of identified buildings in the newspapers for public awareness.	4.53	1.18	4.61	0.98	SA
7.	Inadequate engagement of different professionals in government agencies and building industries to assess and certify building plans before final approval is given.	4.69	1.24	4.58	0.93	SA
8.	Inadequate public enlightenment programme to sensitize the public on the implications of patronizing quacks and using unapproved design for building construction.	4.54	1.13	4.63	1.05	SA
9.	Utilization of flood-prone areas for building construction without appropriate foundation.	4.81	2.16	4.66	1.22	SA
10.	Inadequate availability of testing equipment in materials testing laboratories in government departments and agencies.	4.77	0.39	4.70	1.01	SA
11.	Excessive rush during building construction.	4.92	0.25	4.69	0.49	SA
12.	Low remuneration of building staff and other relevant government agencies to ensure that standards are not compromised.	4.59	1.19	4.52	0.92	SA
13.	Excessive and unnecessary loading of building often result in structural failures.	4.83	1.07	4.57	2.06	SA
14.	Inadequate assessment of building materials imported into the country in line with Nigeria's building code.	4.56	0.36	4.61	1.13	SA
15.	Lack of signed undertaken against illegal conversion and alteration of building plan by Clients and professionals in the building industries.	4.58	2.04	4.55	1.95	SA
	Grand Mean and Standard Deviation	**4.67**	**1.26**	**4.60**	**1.15**	**SA**

Note: SA = Strongly Agreed

The data presented in Table 3 shows responses from registered Civil Engineers on the causes of structural failures that lead to building collapses in Abuja and Lagos between 1984 and 2023. The respondents grand Means was 4.67 and 4.60 for Abuja and Lagos respectively. This implies that the respondents strongly agreed that lack of monitoring of building construction, use of quacks and unapproved plan, inadequate site investigation and appropriate

material tests, lack of prosecution of offender(s) who carryout building construction without complying with Nigeria's building code, inadequate auditing of buildings stability, inadequate remuneration, inadequate assessment of building materials imported into the country, lack of signed undertaken against illegal conversion and alteration of building plan by clients and professionals in the building industries were the causes of building collapse in Abuja and Lagos, Nigeria between 1984 and 2023.

Research Question 4: What are the strategies that can effectively mitigate the causes of structural failures that lead to building collapses in Nigeria?

Table 4: *Strategies to mitigate the causes of structural failure that result in building collapse in Nigeria.*

S/N	Section B: Measures to Mitigate Structural Failure	CE in ABUJA X	CE in ABUJA SD	CE in LAGOS X	CE in LAGOS SD	DEC.
1.	Government agencies saddled with the responsibilities to monitor building construction should ensure compliance to Nigeria's building code and regulations.	4.63	1.24	4.45	1.14	SA
2.	Only qualified and licensed professionals should be allowed to carry out construction and supervision of building construction.	4.55	1.13	4.52	1.07	SA
3.	Site investigation, Environmental impact assessment (EIA) and structural analysis should be presented as mandatory requirements to planning authorities before building plan approval.	4.51	2.17	4.55	1.83	SA
4.	Offender(s) who carryout building construction without complying with Nigeria's building code and regulations should be prosecuted.	4.50	1.15	4.51	1.09	SA
5.	Building Collapse Monitoring Unit (BCMU) should be created for periodic assessment and demolitions of buildings that have exceeded Development Control.	4.53	1.08	4.57	1.05	SA
6.	Laboratory Test should be used to audit the stability of buildings in order to avert the collapse of distressed buildings.	4.56	0.89	4.54	1.08	SA
7.	Professionals in building industry should be engaged to assess and certify building plans before final approval is given.	4.59	1.14	4.51	0.83	SA
8.	Public enlightenment programme should be organized by government agencies, professional bodies in collaboration with the media to sensitize the public on the implications of patronizing quacks and using unapproved design for construction of building.	4.52	2.16	4.53	1.17	SA
9.	Town Planning and States capital city development Authority should discourage building construction on flood-prone areas to guide against foundation failure.	4.61	1.18	4.43	1.14	SA
10.	Laboratory Test and other testing equipment should be made available in government materials testing laboratories and agencies.	4.52	1.11	4.41	1.19	SA
11.	Professionals should avoid excessive rushed during building construction as a measure to guide against structural failures.	4.54	0.97	4.36	1.03	SA
12.	Standard Organization of Nigeria and other relevant agencies should be adequately remunerated to effectively perform their duties.	4.63	1.22	4.41	1.06	SA

13.	Professionals should avoid excessive and unnecessary loading of building as a measure to guide against structural failures.	4.51	2.14	4.46	1.48	SA
14.	Standard Organization of Nigeria should ensure that building materials imported into the country conforms to standard requirements and Nigeria's building code.	4.66	1.17	4.41	1.07	SA
15.	Client and professionals in the building industries should sign undertaken against illegal conversion, alteration, and any additions to existing structures.	4.61	0.96	4.40	1.11	SA
	Mean and Standard Deviation	**4.56**	**1.31**	**4.47**	**1.16**	**SA**

Note: SA = Strongly Agreed

The data presented in Table 4 shows responses from registered Civil Engineers on strategies to eliminate the causes of structural failure that result in building collapse in Nigeria. The result of the study revealed that adequate monitoring of building construction, use of professionals and approved plan, adequate site investigation and appropriate material tests, prosecution of offender(s) who carryout building construction without complying with Nigeria's new building code, adequate auditing of buildings stability, adequate remuneration, adequate assessment of building materials imported into the country, signing of undertaken against illegal conversion, and alteration of building plan by clients and professionals in the building industries are the strategies to eliminate the causes of structural failure that result in building collapse in Nigeria.

Hypothesis 1: There is no statistically significant difference in the mean responses of Civil Engineers in Abuja and Lagos on the cases of structural failures that result in building collapses in Nigeria between 1984 and 2023.

Table 5: *Independent t-test analysis of difference between the mean response of Civil Engineers in Abuja and Lagos on the causes of structural failures that result in building collapse in Nigeria between 1984 and 2023.*

Variable	N	$\bar{x}$	SD	df	Mean Diff.	t-cal.	t-crit.	Decision
Abuja CE	30	4.67	1.26					
				58	0.07	1.27	1.67	NS
Lagos CE	30	4.60	1.15					

Note: NS = Not Significant

The data presented in Table 5, the calculated t-value is 1.27 (t_{cal}=1.27) and the critical t-value is 1.67 (t_{crit} =1.67) at 58 degrees of freedom and Mean difference of 0.07 at 0.05 level of significance. Since the t_{crit} =1.67 is greater than the t_{cal}=1.27, the null hypothesis is upheld, indicating that the null hypothesis of no significant difference between the mean response of Civil Engineers in Abuja and Lagos on the causes of structural failure that result in building collapse in Nigeria between 1984 and 2023 was upheld. This implies that the Civil Engineers in Abuja and Lagos strongly agreed that the items statements in Table 3 are the causes of structural failure that result in building collapse in Nigeria between 1984 and 2023.

Hypothesis 2: There is no statistically significant difference in the mean responses of Civil Engineers in Abuja and Lagos on strategies to mitigate the causes of structural failures that result in building collapses in Nigeria between 1984 and 2023.

Table 6: *Independent t-test analysis of difference between the mean response of Civil Engineers in Abuja and Lagos on the strategies to eliminate the causes of structural failure that result in building collapse in Nigeria*

Variable	N	$\bar{x}$	SD	df	Mean Diff.	t-cal.	t-crit.	Decision
Abuja CE	30	4.56	1.31					
				58	0.09	0.47	1.67	NS
Lagos CE	30	4.47	1.16					

Note: NS = Not Significant

The data presented in Table 6, the calculated t-value is 0.47 (t_{cal}=0.47) and the critical t-value is 1.67 (t_{crit} =1.67) at 58 degrees of freedom and Mean difference of 0.07 at 0.05 level of significance. Since the t_{crit} =1.67 is greater than the t_{cal}=0.47, the null hypothesis is upheld, indicating that there is no significant difference between the mean response of Civil Engineers in Abuja and Lagos on the strategies to eliminate the causes of structural failure that result in building collapse in Nigeria. This implies that the Civil Engineers in Abuja and Lagos strongly agreed that the items statements in Table 4 are the strategies to eliminate the causes of structural failure that result in building collapse in Nigeria.

Discussion of Findings

The findings of the study presented in Table 1 shows reported cases of building collapse, causes and characteristics which include number of floors, usage of the building, location of the building, year of building collapse and casualties/fatalities of collapsed buildings. The study reported cases covered a time frame between 1984 and 2023. This is consistent with the study by Fakere, Fadairo and Fakere (2012), Ebehikhalu and Dawam (2014), Chendo and Obi (2015), Chendo and Obi (2015), Michael and Oyewale, (2018), Obodoh, Nwachukwu and Obodoh (2019), Awe, et al., (2023), who reported cases of building collapse, causes and characteristics which include number of floors, usage of the building, location of the building, year of building collapse and casualties/fatalities of collapsed buildings between 1984 and 2023.

The findings of the study presented in Table 2 shows frequency and percentage of reported cases of building collapse and numbers of lives lost in Abuja and Lagos between 1984 and 2023. The reports revealed that Abuja has 9 cases of building collapse and 114 numbers of lives lost while Lagos has 108 cases of building collapse and 460 numbers of lives lost. This implies that Lagos State has the highest numbers of building collapse and lives lost between 1984 and 2023. This is consistent with the study by Fakere, Fadairo and Fakere (2012), Ebehikhalu and Dawam (2014), Chendo and Obi (2015), Chendo and Obi (2015), Michael and Oyewale, (2018), Obodoh, Nwachukwu and Obodoh (2019), Awe, et al., (2023), who revealed that Abuja has 9 cases of building collapse and 114 numbers of lives lost while Lagos has 108 cases of building collapse and 460 numbers of lives lost.

The findings of the study presented in Table 3 indicate responses from registered Civil Engineers on the causes of structural failure that result in building collapse in Nigeria between 1984 and 2023. The result of the study revealed that lack of monitoring of building construction, use of quacks and unapproved plan, inadequate site investigation and appropriate material tests, lack of prosecution of offender(s) who carryout building construction without complying with Nigeria's building code, inadequate auditing of buildings stability, inadequate remuneration, inadequate assessment of building materials imported into the country, lack of signed undertaken against illegal conversion and alteration of building plan by clients and professionals in the building industries were the causes of building collapse in Abuja and Lagos, Nigeria between 1984 and 2023.

The corresponding hypothesis five revealed that there is no significant difference between the mean response of Civil Engineers in Abuja and Lagos on the causes of structural failure that result in building collapse in Nigeria between 1984 and 2023 was upheld. This implies that the Civil Engineers in Abuja and Lagos strongly agreed that the items statements in Table 3 are the causes of structural failure that result in building collapse in Nigeria between 1984 and 2023. This is consistent with the study conducted by Oloyede, Omoogun and Akinjare (2010), Orikpete and Ewim (2023) and Oyedele (2018) that described the causes of building failure as incompetent contractor, faulty construction methodology, poor Town Planning approval/development monitoring process, non-compliance with specifications/standards by developers/contractors, use of substandard materials and equipment, inadequate supervision or inspection/monitoring, economic pressures, incompetent/illegal conversion and change of use of buildings.

The data presented in Table 4 shows responses from registered Civil Engineers on strategies to eliminate the causes of structural failure that result in building collapse in Nigeria. The result of the study revealed that adequate monitoring of building construction, use of professionals and approved plan, adequate site investigation and appropriate material tests, prosecution of offender(s) who carryout building construction without complying with Nigeria's new building code, adequate auditing of buildings stability, adequate remuneration, adequate assessment of building materials imported into the country, signing of undertaken against illegal conversion, and alteration of building plan by clients and professionals in the building industries are the strategies to eliminate the causes of structural failure that result in building collapse in Nigeria. The corresponding hypothesis six revealed that there is no significant difference between the mean response of Civil Engineers in Abuja and Lagos on the strategies to eliminate the causes of structural failure that result in building collapse in Nigeria. This implies that the Civil Engineers in Abuja and Lagos strongly agreed that the items statements in Table 4 are the strategies to eliminate the causes of structural failure that result in building collapse in Nigeria. This is consistent with the study by Oguntimehin, and Adejugbagbe (2019) who recommended that Standard Organization of Nigeria should increase their effort in sanitizing building materials in the market and that professional bodies in building industry should ensure proper supervision of workmen and efficient checking of materials before incorporation into building works.

Conclusion

The comprehensive assessment of building collapses in Abuja and Lagos between 1984 and 2023 reveals a complex interplay of factors contributing to these recurrent tragedies. The study concluded that despite technological advancements, building collapses persist primarily due to lack of monitoring, use of quacks and unapproved plan, inadequate site investigation and appropriate material tests among others were the causes of building collapse in Abuja and Lagos, Nigeria between 1984 and 2023. These factors, among others, have resulted in loss of life, property damage, and various degrees of injuries in Abuja and Lagos, Nigeria. The study identified nine (9) cases of building collapse in Abuja and one hundred and fourteen (114) numbers of lives lost while in Lagos, recorded one hundred and eight (108) cases of building collapse and 460 numbers of lives lost. This implies that Lagos State has the highest numbers of building collapse and lives lost between 1984 and 2023. Addressing these issues is crucial to preventing future collapses and ensuring the safety and resilience of urban infrastructures in these rapidly growing cities. This paper provides proactive steps to create a safer built

environment, ultimately protecting the lives and properties of residents in Abuja and Lagos and fostering sustainable urban development.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. The Nigerian Institute of Town Planners and Standard Organization of Nigeria should ensure that building construction and materials imported into the country are tested and standards not compromised.
2. Only qualified and licensed Architect, Engineering and Construction (AEC) professionals should be allowed to carry out assessment, certification, construction and supervision of building construction.
3. Site investigation, Environmental Impact Assessment (EIA) and structural analysis should be presented as mandatory requirements to planning authorities before building plan approval.
4. Building Inspection Unit (BIU) should be created under the existing statutory Town Planning to conduct regular and unannounced inspections to ensure compliance with building standards and promptly address any violations.
5. Government agencies and regulatory bodies should implement and strictly enforced stringent building codes and regulations that are regularly updated to reflect current best practices and technological advancements in construction.
6. Adopt advanced construction technologies such as Building Information Modeling (BIM) and structural health monitoring systems to enhance the accuracy of designs, improve project management, and provide real-time data on the structural integrity of buildings.
7. Government agencies and regulatory bodies should invest in the continuous training and certification of architects, engineers, and construction workers on programs that emphasize the latest construction techniques, safety protocols, and ethical practices in the building industry.

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