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Investigating The Socio – Economic and Environmental Impact of Building Collapse in Nigeria, (A Case Study of Jos Metropolis, Plateau State)

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Abstract: ***This study aimed to examine building collapses in Nigeria, focusing on Jos metropolis in Plateau State as a case study. The specific objectives were to investigate the Socio-Economic and Environmental Impact of building collapses in Jos metropolis, identify the primary causes, evaluate the supervisions rated factors which has contributed to building collapse in Jos metropolis, Plateau State, and recommend solutions to reduce or eliminate such incidents. A quantitative (descriptive) research design was employed, targeting site workers from three selected construction companies in Jos metropolis. A sample size of 91 respondents was selected using a convenient sampling method, with 85 valid responses. Data collection was conducted via questionnaires and analysed using frequency tables and mean scores, the findings indicated a high frequency of building collapses in Jos metropolis, with key causes including poor design, construction faults, substandard materials, improper construction methods, foundation failures, ineffective supervision, and inadequate maintenance. Based on these findings, the study suggests that members of the Nigerian Institute of Building (NIOB) and the Nigerian Institute of Structural Engineers (NISE) should be actively engaged in the federal government's efforts to raise awareness about building materials. Furthermore, developers should designate materials engineers for large-scale construction projects.***

Keywords: Building Collapse, Building Materials, Jos Metropolis & Substandard Materials

1.0 Introduction

Since the 1970s, developed nations have been attempting to prevent building collapses caused by accidents involving significant structural systems. These accidents involve burdens that were not accounted for during design (such as sabotage and gas explosions), extreme environmental effects, and severe fires. According to Ameh, Odusami, & Achi (2017), the frequency of building collapses in Nigeria over the past several years and recently has been extremely frightening and unsettling. Accordingly, many lives and assets have been lost due to the collapse of buildings in Port Harcourt, Abuja, and Lagos. Many property owners have developed hypertension, and others have died prematurely. Oseghale, Ikpo and Ajayi (2015) identified and evaluates the causes and Effects of Building Collapse in Lagos State, Nigeria.

The study found that the primary causes of building failures include poor design, defective construction, excessive loading, lack of approved drawings, possession of approved drawings but failure to comply, and the use of unqualified workers. Adebowale et al. (2016) highlighted that the repercussion of building collapses often results in financial and societal consequences, such as the loss of life, destruction of materials, depletion of capital investment, physical damage, and psychological distress. Chendo and Obi (2015) outlined the outcomes of building collapses in Nigeria, which include the loss of lives and properties, significant setbacks, damage to reputation and trust, loss of future contracts, revocation of professional licences, and loss of materials and investments. Oke (2016), in his study on the causes and effects of building collapse in Nigeria, pointed out that in addition to the loss of lives, particularly among innocent civilians, many people suffer permanent disabilities as a result of the increasing rate of building failures.

Also, recently in Bukuru, Jos South of Plateau State a two-storey recently collapsed though there was no report of fatality. Nonetheless, significant strides have yet to be made in confronting this problem. In 2020, at least thirty people escaped being killed after a storey building collapsed at the Yanshanu suburb of Jos, Plateau state. The building housing eight households, it was gathered, collapsed after a heavy downpour however, several studies have been carried out on building collapse in different states of the country but there has been a dearth of literature of building collapse in Plateau State thus this study will be as investigating the socio-economic and environmental impact of building collapse in Nigeria using Jos metropolis, Plateau State as a case study.

2.0 Literature Review

The concept of building generally refers to the process of creating physical structures or environments, often involving construction, design, planning, and implementation. It encompasses various aspects such as architecture, engineering, materials science, and project management, all aimed at constructing functional and aesthetically pleasing spaces that fulfil specific purposes or needs.

According to Odusola, Atta, and Ayangade (2019), there are a few fundamental criteria that a structure has to fulfil before it can be considered complete. These criteria include buildability, design performance, cost efficiency, quality, and safety. According to Tauheed (2007) cited in Oseghale, Ikpo, and Ajayi (2015), if these requirements aren't met in terms of the building's materials, design, or construction, the structure might collapse.

Legal Framework for Building Industry

The building industry plays a vital role in driving sustainable economic growth and development of any nation. According to Ayininuola and Olalusi (2015), construction production typically accounts for more than half of Nigeria's gross fixed capital budget. According to Akinpelu (2018), the Building Industry, which is a sub sector of the Construction Industry, is the most complicated of all the industries that make up the Nigerian economy today. The complexity of the industry arises from its fundamental role as the foundation on which all other sectors of the social economy rely to operate effectively. There are several widely recognised and accepted standards and guidelines for architectural planning and building development. The National Building Code is currently undergoing revision and is being prepared for enactment by Nigeria's parliament in response to the frequent incidence of building collapse structures that have been reported in the country. Despite this, many regions have yet to adopt the necessary local strategies to support regulation enforcement. Consequently, the anticipated results have still not come to fruition. (CORBON 2016). The Building Code is a collection of legislative requirements whose objective is focused on promoting optimal approaches in the planning, development, and upkeep of structures to enhance the well-being, security, and interests of those who occupy them.

A. **Concept of Building Collapse**

In the lexicon of building design and engineering, the term "collapse" signifies the breakdown of a mechanical system. Corollary, when a structure suddenly collapses down or caves in, this is known as a building collapse. Buildings that collapse typically shatter into pieces. Before it actually topples, a structure of any kind will almost certainly show signs that it is hazardous. The most extreme form of construction failure is the collapse of a structure. According to the findings of a research that was carried out by (Olajumoke, Oke, Fajobi, and Ogedeng 2019), poor craftsmanship and the use of material that is not up to grade account for around 37% of the overall reasons for structural crash in Nigeria.

Overview and Causes of Building Collapse

Globally, people and societies place a high level of importance on housing as one of the most important variables that influences both the comfort and satisfaction of its members. This has an important role in ensuring that the societal challenges and requirements are met, it also has an impact on the well-being, health, and safety of both the current generation and the generations to come. Ibrahim (2020) averred that the problem of inadequate shelter represents one of the leading challenges confronting governments on every continent. In Nigeria, building failure count in recent years has reached an epidemic scale.

According to what Adebayo (2013) mentioned in Chendo and Obi (2015) stated that the frequent occurrence of collapse incidents has turned into a wide spread issues that has resisted all efforts to find lasting solutions in recent years. These events have caused significant loss of life and property, leaving many individuals with permanent impairments.

Ayedun, Durodola, and Akinjare (2018) emphasize that the growing incidence and severity of structural failures have become a major concern not only for governmental authorities but for all responsible citizens, particularly those within the construction industry. The scale of these incidents is reaching alarming levels. Despite the pervasive dissemination of engineering knowledge over the years, such failures continue to occur. This raises the critical question of whether industry stakeholders have conducted a comprehensive analysis of the root causes of these structural breakdowns and identified effective strategies or actions to mitigate them. This evident gap in response serves as the foundation of this study, which explores the geographical patterns of such failures in Nigeria, aiming to uncover the contributing factors, associated challenges, and possible solutions to address the issue.

Notably, of all factors prompting building collapse is negligence, faulty design, aging, material fatigue, harsh operating and climatic conditions, accidents, terrorist attacks, and natural disasters are only some of the common causes of structural failure throughout time. There are two types of building failures: cosmetic failures, caused by alterations to the building's appearance, and structural failures, which compromise the building's stability as well as its visual appeal (Aayuba, Olagunju, & Akande, 2015). Olusola, Ojambati and Lawal (2017) noted that contractors' greed, such as using subpar products to maximize profit, diverting cement and other construction supplies intended for the client's project to their own, contributes to building failures. when examining structural breakdowns, distinguishing between those that occur during construction phase or within their expected lifespan is crucial. (about 25 years) when considering the subject of building collapse. It seems to reason that the most devastating collapses happen to buildings that have been in use for an extended period of time or are relatively new.

According to Ayininuola and Olalusi (2015), design flaws account for 50% of building failures in Nigeria, construction site flaws account for 40%, and product flaws account for 10%. Hall (2015) added that the application of inadequate building resources, poor workmanship, flawed design were the primary contributors to building breakdown. According to Yusuf (2006) referenced in Ede (2019), the causes may be categorized as tangible factors, environmental condition of the site, arrangement of technological elements, societal, financial, technic and administrative factors. Bizarrely, building collapses frequently result from poor design, poor construction, foundation failures, abnormal loads, the employment of incompetent contractors, insufficient monitoring, and, most importantly, a failure by the responsible town planning officials to enforce building standards (Consumer News, 2012).

The following are listed by Akinpelu (2018) as the main reasons of building collapse. Environmental changes, risks both natural and created by humans, and poor presentation and understanding of the design are some of them. When weights placed on a structure's structural frame exceed it carrying capability, the building will collapse.

Ebehikhalu & Dawam (2016) conducted a geographical assessment of building failures in Nigeria, exploring the factors and challenges associated with these events. Their research points to a variety of issues that lead to these failures, such as structural inadequacies, lack of proper

oversight, or poor labour quality, the use of inferior materials, defective or missing engineering plans, negligence, intense weather situations like heavy rainfall, unstable foundations, overload, unauthorized modifications, failure to adhere to established building standards, rushed timelines, clients lacking awareness or motivated by profit, and structural decay along with poor drainage.

The study also reports that from 1974 to 2012, 140 buildings were recorded to have failed, resulting in over 798 fatalities. Of these incidents, 54.17% were residential properties, with an additional 15.83% residences still in construction. Business structures made up to 10% of these cases, educational dwellings 8.33%, and places of worship, including churches and mosques, 5.00%. hotels accounted for 2.50%, while courts, healthcare facilities, sport complexes each represented 1.67%, and 0.83%, respectively.

Consequences of Building Collapse

The rising number of building collapses in the country has resulted in not only the loss of life (mainly innocent residents), but also the permanent disability of many more. The monetary toll of this tragedy is incalculable, since numerous homes and businesses were destroyed. In addition, the dispersed sites of building collapse across Nigeria have a negative impact on public health since these abandoned structures are being used as safe havens by criminals. The NIDB building in Lagos, Nigeria, a state with a thriving economy, is a great illustration of this. Building collapses in Nigeria have claimed many lives and destroyed countless assets, with long-term repercussions for the country's economy and society that will be felt for centuries to come (Olajumoke et al., 2019). In 20.3% of building collapse accidents examined by Windapo and Rotimi (2015), no fatalities were reported; in 44.4% of incidents, between 1 and 5 lives were lost; and in 9.3% of incidents, over 21 lives were lost.

The number of lives lost in building collapse occurrences is indicative of the gravity of the issue, and in cases when no lives were lost, the resulting bodily injuries are no less devastating Monetary/Market Vulnerabilities, Social/Governmental Uncertainties, Personnel/Operational Hazards, Ecological/sustainability Challenges, Structural/Material Threats, Regulatory/Compliance concerns are the six categories into which Janssen's et al. (2019) classify the hazards of building collapse.

3.0 Methodology

For this analysis, the researcher employed an approach based on ease of access to determine the participant count. From the total number of site workers at three selected construction firms in the Jos area, the investigator picked 31 individuals from each firm, resulting in a total of 91 subjects for this study. Torty (2021) describes a convenience sample as one where individuals are chosen due to their accessibility or proximity to the investigator. Nwana (2005) outlines sampling methods as organised procedures to select specific people under controlled conditions. The research utilized a method that relied on accessibility to select respondents from the entire group.

Method of Data Collection

Data was collected using two approaches: primary and secondary methods. The primary techniques involved administering questionnaire, while secondary sources included textbooks, websites, academic journals, and government reports.

Instrumentation

The study used a set of questions distributed to the selected individuals. This set was organised into two: the first gathered personal or demographic details, while the second focused on addressing the research's main question. Respondents indicated their answers by marking the relevant column. The researcher directly managed the distribution process.

Method of Data Presentation and Analysis

The answers were examined by employing occurrence charts*, which delivered insights into the study's inquiries.*

SA	=	*Strongly Agree*	*5*
A	=	Agree	4
D	=	Disagree	3
SD	=	Strongly Disagree	2
N	=	Neutral	1

Decision Rule:

This formula was applied to determine the selection criteria.

$$\frac{5+4+3+2+1}{5} = \frac{15}{5} = 3.0$$

Result of 3.0 or higher was accepted, while any score below it was rejected. Thus, this served as the cut-off for decision-making. The hypotheses were tested using the Chi-square statistical method.

Plate 1: A storey building collapsed in Bukuru, near Jos, Plateau State, Sunday night.
Source: Sahara reporters (2022)

Plate 2: A three storey Building collapse on Butcher Street, Dilimi area of Jos, Plateau State.
Source: Idowu (July 16, *2022).*

Plate 3: Recent Reported case of Collapsed Buildings in Jos Metropolis

Categories of building frameworks: multi-level structures
Site of location: Yanshanu Suburb of Jos, Plateau State.
Date of Collapse: 3rd October, 2020
Suspected Cause(s): Natural Disaster, inadequate supervision of construction work and poor-quality control
Remarks (lives lost): Nill
Remedies: Expert committee could be appointed to evolve guidelines and norms to be followed by the licensed supervising engineer, Standard building materials should be used.

4.0 Presentation of Results and Discussion

This research was aimed to explore the Socio-Economic and Environmental Impact of building collapse in Nigeria using Jos metropolis, Plateau State as a case study.

The study provides a comprehensive presentation, analysis, and interpretation of data obtained from a questionnaire distributed to respondents. It seeks to answer the following research questions:

1. Which factors primarily contribute to construction failure in Jos metropolis, Plateau State?
2. What are the supervisions rated factors which has contributed to building collapse in Jos metropolis, Plateau State?
3. How do building breakdown affect Jos metropolis, Plateau State?
4. What are the recommendations on how structural failure can be reduced or totally stopped?
5. How do the government and other stakeholders help in the reduction of construction collapse in Jos metropolis Plateau State?

The summary of the survey is presented in the following table. A sample of 91 was selected for the study, with 89 completed entries submitted. However, only 85 were deemed valid for analysis due to incomplete, incorrect, or inappropriate information. As a result, 85 approved responses were used for the assessment.

Table 1: Distribution of Questionnaire

Questionnaire	Frequency	Percentage
Sample size	91	100
Received	89	98
Validated	85	93

Table 2: Demographic profile of the respondents

Demographic Information	Frequency	Percent
Gender		
Male	75	88%
Female	10	12%
Age		
18-25	10	12%
26-35	17	20%
36-45	42	49%
46+	16	19%
Education		
SSCE	13	15%
OND	26	31%
BSC/HND	38	45%
MASTERS	08	9%
PHD	03	4%
Marital Status		
Married	38	45%
Separated	16	19%
Single	14	16%
Divorced	09	11%
Widowed	08	13%

Question 1: ***Which factors primarily contribute to construction failure in Jos metropolis, Plateau State?***

Table 3: Mean Responses on the main causes of building collapse in Jos metropolis, Plateau State.

S/N	DESCRIPTION	X	S.D	N	DECISION
1	Poor design	3.5	4.5	85	Approved
2	Defective building practices	3.3	4.2	85	Accepted
3	Low-quality material	3.5	4.4	85	Admitted
4	Construction techniques	3.6	4.6	85	Approved
5	Foundation failure	3.4	4.3	85	Accepted
6	Inadequate maintenance	3.8	4.8	85	Admitted

From the responses derived as described in table 3 on the main causes of structure collapse in Jos metropolis, Plateau State, the table shows that all the items(item1-item6): stating; flawed arrangement, defective building techniques, deficient components, method of construction, foundation breakdown, and inadequate maintenance, all with mean score of 3.5, 3.3, 3.5, 3.6, 3.4, and 3.8 were accepted. This indicates that respondents accepted the factors that causes building failure in Jos metropolis, Plateau State. This is proven as the respective items (item1-item6) had mean scores of 3.0, and above.
Hamma-Adama and Kouider (2017), also highlighted some of the major factors of building collapse in their findings as carelessness, quackery, inconsistent supervision among others which validates the data in this study.

Question 2: What are the supervisions rated factors which has contributed to building collapse in Jos metropolis, Plateau State?

Table 4: Mean Responses on the supervision rated factors which has contributed to building collapse in Jos metropolis, Plateau State.

S/N	DESCRIPTION	X	S.D	N	DECISION
1	Construction of unapproved building pattern	3.8	4.7	85	Accepted
2	Improper compliance to building codes and regulations	3.3	4.2	85	Accepted
3	Lack of proper supervision of building construction	3.2	4.1	85	Accepted
4	Lack of effective supervision of building materials provided	3.6	4.5	85	Accepted
5	Lack of thorough supervision of site from the inception to the final stage of the project	3.4	4.4	85	Accepted

From the responses derived as described in table 4 on the supervision rated factors which has contributed to building collapse in Jos metropolis, Plateau State, the table shows that all the items(item1-item5): stating; construction of unapproved building pattern, improper compliance to building codes and regulations, lack of proper supervision of building drawings, lack of effective supervision of building materials provided, and lack of thorough supervision of site from the inception to the final stage of the project, all with mean score of 3.8, 3.3, 3.2, 3.6, and 3.4 were accepted. This indicates that respondents accepted the supervision rated factors which has contributed to building collapse in Jos metropolis, Plateau State. This is proven as the respective items (item1-item5) had mean scores of 3.0 and above. Agwu, M. (2014), discusses the impact of ineffective supervision and the failure of regulatory bodies to enforce compliance with construction standards, which is directly related to the issues identified in the research.

Question 3: What are the effects of building collapse in Jos metropolis, Plateau State?

Table 5: Mean Responses on the effects of building collapse in Plateau State.

S/N	DESCRIPTION	X	S.D	N	DECISION
1	Loss of lives	3.4	4.3	85	Accepted
2	Destruction of property	3.3	4.2	85	Accepted
3	Incapacity of the injured	3.1	4.0	85	Accepted
4	Financial losses	3.6	4.6	85	Accepted
5	Wastage of time and valuable resources	3.5	4.5	85	Accepted

From the responses derived as described in table 5 on the effects of building collapse in Jos metropolis, Plateau State, the table shows that all the items(item1-item5): stating; loss of lives, destruction of property, incapacity of the injured, financial losses, and wastage of time and valuable resources, all with mean score of 3.4, 3.3, 3.1, 3.6, and 3.5 were accepted. This indicates that respondents accepted the effects of building collapse in Jos metropolis, Plateau State. This is proven as the respective items (item1-item5) had mean scores of 3.0, and above.

Olagunju, Aremu, & Ogundele, (2013), analyse the devastating impact on both individual and the economy, noting that the breakdown of structures leads to the loss of lives and large-scale destruction of property, which further exacerbates poverty in affected places. The findings corroborate with this studies as it agrees to the presentations.

Question 4: What are the recommendations on how building collapse can be reduced or totally stopped?

Table 6: Mean Responses on the recommendation on how building collapse can be reduced or totally stopped

S/N	DESCRIPTION	X	S.D	N	DECISION
1	Adequately monitoring the imported building materials	3.8	4.7	85	Accepted
2	Exclusive supervision of building activities in the state	3.4	4.3	85	Accepted
3	Issuing license to qualified contractors	3.5	4.5	85	Accepted
4	Enforcing accountability by all licensed contractors	3.2	4.1	85	Accepted
5	Punishing contractors and sub-contractors found guilty	3.6	4.6	85	Accepted

From the responses derived as described in table 6 on the recommendation on how building collapse can be reduced or totally stopped, the table shows that all the items(item1-item5): stating; adequately monitoring the imported building materials, exclusive supervision of building activities in the state, issuing license to qualified contractors, enforcing accountability by all licensed contractors, and punishing contractors and sub-contractors found guilty, all with mean score of 4.7, 4.3, 4.5, 4.1, and 4.6 were accepted. This indicates that respondents accepted the recommendation on how building collapse can be reduced or totally stopped. This is proven as the respective items (item1-item5) had mean scores of 3.0, and above.

Question 5: What are the roles played by government and other stakeholders in the reduction of building collapse in Jos metropolis Plateau State?

Table 7: Mean Responses on the roles played by government and other stakeholders in the reduction of building collapse in Jos metropolis, Plateau State.

S/N	ITEM STATEMENT	X	S. D	N	DECISION
1	Formulation of favourable policies	3.6	4.6	85	Accepted
2	Enactment of the policies	3.3	4.2	85	Accepted
3	Regulating of the construction industry	3.5	4.5	85	Accepted
4	Control of the entry of substandard materials into the country	3.4	4.3	85	Accepted
5	Periodic assessment of buildings for maintenance as at when due	3.5	4.5	85	Accepted

From the responses derived as described in table 7 on the roles played by government and other stakeholders in the reduction of building collapse in Jos metropolis, Plateau State, the table shows that all the items(item1-item5): stating; formulation of favourable policies, enactment of the policies, regulating of the construction industry, control of the entry of substandard materials into the country, and periodic assessment of buildings for maintenance as at when due, all with mean score of 4.6, 4.2, 4.5, 4.3, and 4.5 were accepted. This indicates that respondents accepted the roles played by government and other stakeholders in the reduction of building collapse in Plateau State. This is proven as the respective items (item1-item5) had mean scores of 3.0, and above.

5. Conclusion

Our findings from this study revealed that;

a. The major factors that leads to building failure in Jos metropolis, Plateau State includes: poor design, structural issues, substandard resources, method of construction, foundation failure, and inadequate maintenance.
b. The effects of building collapse in Jos metropolis, Plateau State includes: loss of lives, destruction of property, incapacity of the injured, financial losses, and wastage of time and valuable resources.
c. What are the recommendations on how building collapse can be reduced or totally stopped includes: adequately monitoring the imported building materials, exclusive supervision of building activities in the state, issuing license to qualified contractors, enforcing accountability by all licensed contractors, and punishing contractors and sub-contractors found guilty.

Having critically examined the whole exercise of the research work and its findings, the following recommendations are suggested:

a. The Nigerian Institute of Building (NIOB) and The Nigerian Institute of Structural Engineer (NISE) members should be involved in the building materials sensitization process by the federal government. Material Engineers should also be attached to large building projects by their developer.
b. Professionals in the field must ensure effective supervision of workers and conduct thorough checks on resources before they are incorporated into the project.
c. The design team should be cautious when selecting suppliers, ensuring they meet the specified requirements. Materials delivered to the site must be carefully inspected for quality and adherence to contract standards. Plans should also be periodically reviewed throughout the project's progression
d. Skilled workers, particularly for structural tasks, should be employed. Additionally, personnel managers in Nigeria firms must establish training programs for site staff, organising regular workshops and educational sessions to enhance their skills.

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