



IDENTIFICATION, CLASSIFICATION AND RANKING OF THE CAUSES OF BUILDING COLLAPSE IN ABUJA, NIGERIA – A REVIEW

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ABSTRACT

This study examines the incidences of reported building collapses from inception in Abuja, Nigeria from 2008 to 2024 and the attendant increasing loss of lives, properties and injuries, with a view to determining leading causes of building collapses, its classification and ranking within the FCT - Abuja. It also highlights the casualties arising from these occurrences. There has been conflicting information on casualties and damages resulting from building collapses in Nigeria perhaps due to ineffective coordination amongst agencies responsible. Findings of this study revealed the leading causes of building collapse in the FCT in decreasing order as to include Use of sub-standard building materials, structural failures, use of quacks, poor or lack of supervision and lack of conduct of geotechnical investigation/inappropriate foundation. A total of thirty (30) cases of building collapses were identified to have occurred in the FCT leading to the confirmed death of at least fifty-seven (57) persons. Recommendations were made in line with the leading causes of building collapse in the FCT.

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1.0 Introduction

Building collapses are either due to natural climatic and geological conditions or man-made factors. While little may be done to stop the occurrence of the natural causes, the man-made factors can be mitigated to the barest minimum. A building fails when the imposed load cannot be supported by the foundation amongst several other reasons. Building collapse occurs in many places across the world, but the spate of building collapse in Nigeria in recent times is worrisome. The death toll, injuries, psychological trauma and resultant collateral damages occasioned by this phenomenon over the years are high and unquantifiable. In this paper, attempt has been made to re-establish a record of the reported incidences of building collapse in Nigeria and the resultant fatalities as well as the general causes, effects and solutions of building collapse in Nigeria from the findings conducted on some cases. This was however done with respect to frequency of occurrence per annum, category of buildings involved and State of occurrence in Nigeria. Omenihu et al., (2016) defined building collapse as the inability of a building component to withstand the loads it was designed for. Ayinuola and Olalusi, (2004) opined that failure is considered as occurring in a component when such component cannot perform its intended functions. In summary, the unplanned falling of a building is referred to as building collapse, while the planned falling of a building is referred to as demolition.

This paper is structured in the order of introduction, literature review, methodology data analysis and discussion, recommendation and conclusion. The sources of data and methodology for this study were from a review of selected literatures, technical reports, author's independent records and online news articles. Data analysis was done by simple descriptive statistics, counts/frequency of occurrence, rankings and percentages. According to Olusola et al. (2011) and Ketkukah (1998), building collapse may be partial, progressive or sudden. In a partial collapse, only a portion of the building falls down. In the situation of a progressive failure, there will be signs of weakness noticeable either by visible cracks which becomes widened with time or unusual sound in the building due to structural members gradually giving way. In the sudden collapse scenario, the building collapses suddenly, it may not even give any sign prior to collapse. Normally buildings are designed to withstand loads (i.e. live, imposed and wind loads). Collapse or failure of building occurs when parts of building show signs of being unfit for its intended use (Crocker, 1990 cited by Akuboh, 2013). However, building failure or collapse may also result from *force majeure* or natural phenomena/disasters or climatic factors. Similarly, Matawal (2013) noted that the number of building collapse where in most cases the structures and loads came

down without prior warning and the deformation movements, so fast with no time to evacuate, is an indication of improper concreting.

Daily Trust Newspapers of 16th August, 2017 (pages 1, 5) reported that 272 lives were lost in the last 17 Months. This represents an average loss of life of 16 persons per month related to building collapse in Nigeria. Edighoman (2016) reported 151 incidences of Building Collapse in Nigeria from 1974 till March, 2016 from the examination of historical data and outlined some causes of Building Collapse in Nigeria. The contributions of various professionals and the building owner's penchant to avoid cost of hiring professionals were also contained in the paper presentation in relation to building collapse. This work, therefore, draws and reviewed it's historical data from the 151 incidences and updated the incidences of 2012 to April, 2022.

Lawal (2016) opined that hardly can we find a life venture without its elements of risk. Therefore, constructing a building or using a completed building for anything carries a sizeable amount of risk – risk to lives, property, profit and other intangible assets. The fundamental difficulty in risk assessment is determining the rate of occurrence since statistical information is not available on all kinds of past incidents. Furthermore, evaluating the severity of the consequences (impact) is often quite difficult for intangible assets. Thus, best educated opinions and available statistics are the primary sources of information.

The objectives of this study include to ascertain the number of building collapses that occurred in FCT Abuja from inception of occurrence, to evaluate and rank the causes of the building collapses and to adduce the causes of the building collapses according to the stages of building development contained in the National Building Code. To understand why failure occurs, it is important to have an overview of the bath-tub curve. The Bath-Tub Curve or Lusser Mortality curve was established in 1952 by Robert Lusser as the first statistical theory of reliability (Furman, 1981). Figure 1.0 below illustrates the three failure rates of all components and equipment which follows a certain basic pattern namely: Early, Useful life and Wear-out period. This can be likened to a building construction from start to finish including period for concrete curing, behaviours in service and upon aging or prolonged usage.

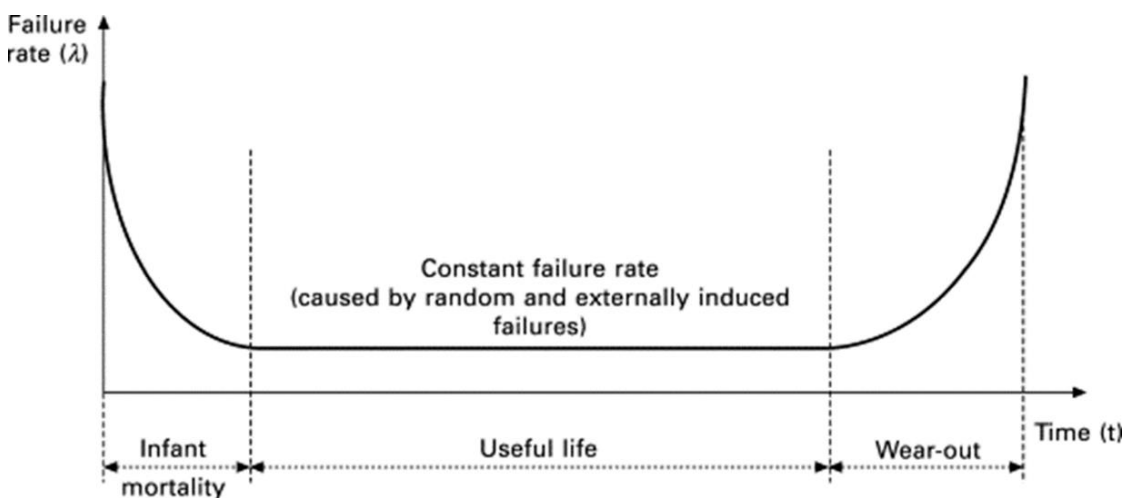


Figure 1: Lusser Mortality Curve (Furman, 1981)

It has been discovered that systems exhibit a high failure rate during their initial period of operations, called the infant mortality period or the debugging stage. These are failures which are typically caused by manufacturing flaws, or the result of damage received in transit or handling. The operating period that follows infant mortality has a smaller failure rate, which tends to remain constant until the beginning of the next phase, called the wear-out period. Failures during these periods are typically due to chance, which is failures generally resulting from severe, unpredictable and usually avoidable stresses that arise from environmental factors such as vibrations, temperature, shock, human factors and pressure. Upon reaching the wear-out period the failure rate tends to increase quite rapidly. Failures in this period are as a result of gradual degradation of some property of the system essential to proper corrosion and abrasion (Furman, 1981). The causes of building collapse globally are either natural such as rainstorm, earthquake, earth tremor, landslide, windstorm, flooding etc or man-made (Akuboh, 2013). However, a review of relevant literature (Akuboh, 2019) in this study reveals the causes of building collapse to include the following:

- Improper Concreting
- Sudden Collapse

- Partial Collapse
- Structural Failure
- Heavy Rainfall
- Unequal Foundation Settlement
- Faulty Foundation Design
- Collapse of adjacent building/fence wall
- Pre-mature removal of formwork for roof slab/concrete decking
- Use of Sub-Standard Materials without government approval in Building Construction
- Poor workmanship and supervision/Quackery
- Inadequate roof and floor slab bracing support
- Use of building when it has not achieved its minimum allowable strength
- Gas Explosion
- Distressed Building
- Illegal addition of floors
- Roof Gutter Failure
- Client's and Contractor's penchant for cheap labour and profit maximization through cutting corners respectively.

The works of Omenihu *et al.* (2016) shows the summary of leading causes of occurrences of factors responsible for collapsed buildings in Nigeria. The results were as follows:

1. Structural failures (24.9%),
2. Substandard materials (13.2%),
3. Poor workmanship (12.2%),
4. Faulty design (8.8%),
5. Use of Quacks (7.3%)
6. Inappropriate foundation (6.8%).

The above leading causes of collapses of buildings in Nigeria were also corroborated by the outcome/findings of numerous investigations carried out by various committees and particularly the Nigerian Building and Road Research Institute (NBRRI) and evidently documented in NBRRI Reports numbers 22, 23, 26, 36, 45, 47 and 51 respectively. In most instances the use of substandard materials and poor workmanship are caused by lack of or inadequate supervision (i.e. human factor).

From the foregoing, it stands to reason that the above factors still constitute the major factors responsible for building collapse. According to Lamptey-Puddicombe (2016), the effects of Building Collapse are as follows:

- Loss of life, property and huge sum of capital.
- Loss of reputation and integrity leading to psychological trauma.
- Loss of new commissions and contracts.
- Loss of materials and capital investments.
- Components and materials are damaged beyond re-use.
- Capital investments are not recoverable, leading to bankruptcy and high economic implications to the nation's economy.



Plate 1: Two Storey Building Collapse in Garki Village, Abuja – 24th August, 2023.



Plate 2: Multi-Storey Building Collapse in Gwarinpa, Abuja – 2nd February, 2023.

2. Materials and Methods

The data used in this review were obtained from secondary sources, which include publications by various authors, Television news, Newspaper articles, online sources/Internet, Conference proceedings of the Quantity Surveyors Registration Council of Nigeria, 2016, some Investigative Reports of the National Building and Road research Institute (NBRRI) on Building Collapses and independent records of the author on building collapse from 2012 to 2024.

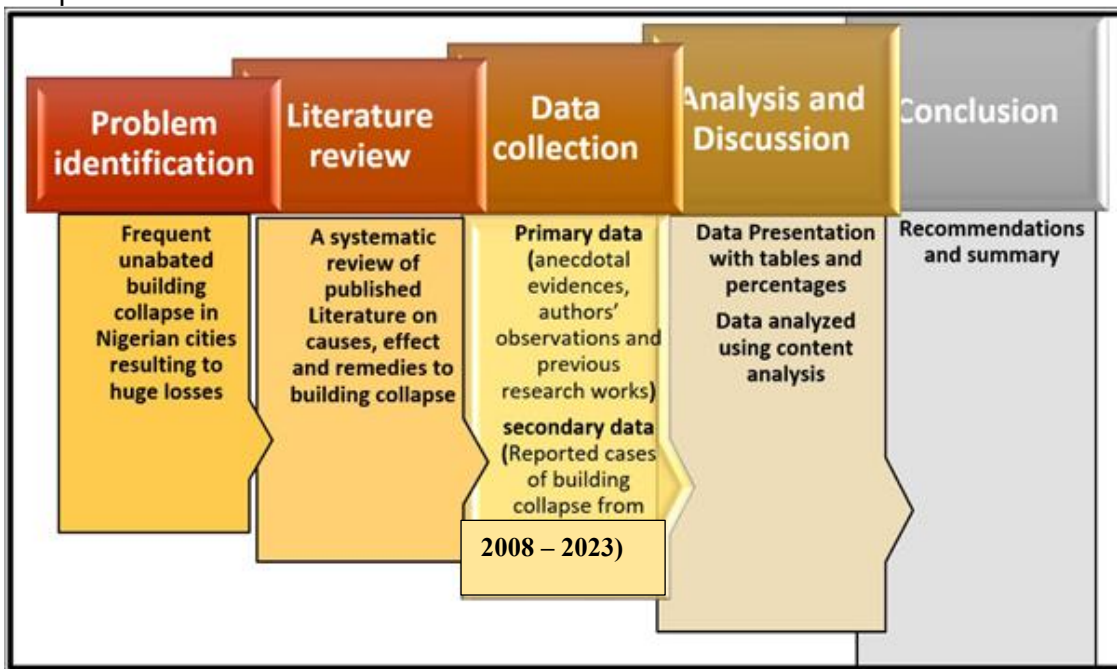


Figure 2: Research Methodology (Nicholas et al., 2021)

3. Results and Discussion

Table I presents the identification of the causes associated with building collapse.

Table I: Identification of the Causes of Building Collapses in Abuja, F.C.T.

S/No.	Building Description	Location/Address	Date of Occurrence	Confirmed/Suspected Causes	Casualties
1	4-Storey Building under Construction	Plots 230 and 1161, POW Mafemi Crescent, Utako District, Abuja	30 th July, 2008	Violation of Stop work Order and quit notice	6 Deaths, 10 Injured
2	3-Storey Building Collapse	Plot 1885 in Cadastral Zone A04 of Asokoro District, Asokoro, Abuja	31 st July, 2009	No Building Approval for the construction due to ownership dispute in court at the time.	1 Death, 35 Recued

S/No.	Building Description	Location/Address	Date of Occurrence	Confirmed/Suspected Causes	Casualties
3	2-Storey Commercial Building	Garki, Abuja	November, 2009	Structural failure, Substandard material	
4	6-Suspended Floors for commercial purpose with a Basement	Plot 702, Port Harcourt Crescent, Area 11, Garki, Abuja	July, 2010	Substandard materials, use of unqualified professionals.	
5	4 Storey Uncompleted Building	2, Ikolie Street, Off Gimbiya Street, Area 11, Garki, Abuja	11 th August, 2010	Substandard materials, disregard for building regulations	23 Deaths, 11 Injured
6	2-Storey Zenith Bank Building	Maraba, Near Abuja	2011	No Geotechnical Investigation, Undersized large span slab, No specific floor thickness on drawing.	2 Deaths, 11 Injured
7	4-Storey Hospital Building	Mpape, Abuja	19 th August, 2011		
8	2 Storey Building Under Construction belonging to the Nigerian Navy Holdings	45th Road, First Avenue, Gwarinpa, Abuja	28th January, 2012	Unapproved and Unsupervised demolition of defective Building occasioned by use of sub-standard materials and inadequate concrete mix ratio.	3 Deaths, 5 Injured
9	1 Storey Commercial Building under construction	Apo Mechanic Village, Abuja	13th June, 2012	No qualified professional on site, poor supervision, use of poor-quality material.	No Deaths, 3 injured
10	2 Storey Building	No. 3, Ademola Awosika Road, Close to Living Faith Church, Kubwa Extension III, Abuja.	8th August, 2012	Poor quality materials, poor workmanship and lack of supervision, weak foundation, failure of structural elements.	2 Deaths, 9 injured
11	A Semi-Detached Duplex Building	Mbora Estate, Abuja	29th September, 2012	Substandard Building Materials	
12	Building Collapse (Unreported)	Maitama, Abuja	6 th September, 2013		3 Deaths
13	A Storey Building	Government Secondary School, Nyanya, Abuja	27 th September, 2013		8 Injured
14	2 Storey Building	Utako, Abuja	18 Oct., 2013	Distressed building marked for demolition.	No Deaths, 1 injured
15	A Construction Site	Jabi, Abuja	25 th December, 2014	Landslide	3 Deaths
16	A Construction Site	Mississippi Street, Maitama, Abuja	12 th July, 2016	Landslide	2 Deaths

S/No.	Building Description	Location/Address	Date of Occurrence	Confirmed/Suspected Causes	Casualties
17	6 Storey Hotel Building Under Construction	444 Crescent, Citec Villas, Gwarinpa, Abuja, Nigeria	29th August, 2016	Poor Concreting, Inadequate Reinforcement Sizes for Structural Elements.	5 Labourers Trapped
18	4-Storey Building	Gwarinpa, Abuja	30 th August, 2016		2 Deaths, 6 Rescued, Several injured
19	Four Storey Building Under Construction	Plot 711, Obafemi Awolowo Way by Asuquo J. Okon intersection in Jabi, Abuja – FCT.	17th August, 2018	Inadequate compliance to procedures, inadequate foundation depth, under-reinforcement, low soil bearing capacity, poor concrete works and poor supervision.	5 Deaths
20	One Storey Building	Plot 59, Dawaki Relocation Layout, Dawaki, Abuja, FCT.	25 th July, 2020	Poor quality materials, poor workmanship, inadequate pad footing, failure of structural elements, use of quacks, reinforcements less than minimum specifications, improper anchorage of reinforcement, inadequate stirrup spacing and unapproved construction drawings.	-
21	2-Storey Building Under Construction	Abdullahi Hamza Road, Beside Freedom in Christ Mission, Close to Aso Savings and Loans Junction, Kubwa, Abuja	26th August, 2022	Quackery and Sharp Practices.	2 deaths, 5 Injured
22	2 Storey Building Under Construction	6th Avenue, Gwarimpa, Abuja	2nd February, 2023	Illegal addition of floor/violation of building plan approval, Sub-Standard Materials and Poor Workmanship.	3 Deaths, 19 Injured
23	4 Storey Hotel Building Under Construction	Plot 654, Dape (Near Berger Clinic), Life Camp, Abuja	3rd July, 2023	Use of sub-standard materials, violation of development control orders.	1 Death
24	2 Storey Building	Lagos Street, Opposite Garki Police Station, Garki Village, Abuja	23rd August, 2023	Torrential Rainfall- Triggered Collapse.	2 Deaths

S/No.	Building Description	Location/Address	Date of Occurrence	Confirmed/Suspected Causes	Casualties
25	Indoor Basketball Sports Hall	Asturf Garden, Wuse Zone 5, Abuja	Around 9th March, 2024	Wind Storm	
26	A Building	Plot 458, Guzape, Abuja	28th June, 2024		0
27	1 Storey/Duplex Under Construction	Prince and Princess Estate, Abuja	29th June, 2024		2 Injured
28	4 Storey Building Under Renovation	23, Nkwere Street, Off Ahmadu Bello Way, Area 11, Garki, Abuja – FCT	1st July, 2024		3 Injured
29	2 Storey Building	Al-Hilal Hotel, Sultan Dasuki Road, Off Gado Nasco Road, Phase 2, Site 2, Kubwa, Abuja	13th July, 2024	Distressed Building & Illegal conversion from Commercial to mixed use.	5 Injured
30	A Building	Sabon Lugbe, Abuja	26th October, 2024	Partial/incomplete demolition	40 Trapped/injured
Total					57 Deaths, 83 Injured, over 81 Recued

3. Data Analysis and Discussion

3.1 Classification of the Causes of Building Collapses in Abuja, F.C.T.

From the findings of the review of available investigation reports from Building collapses in the FCT and Table above, the following combination of common/leading causes of building collapse were categorized and established based on same categorization of project stages in the National Building Code (2006):

3.1.1 A – Pre-design Causes:

- Building without the required regulatory approvals for design and construction or contravention of approved building plans.
- Client and Contractor’s penchant to cut corners/cost and/or maximize profit.
- Poor Building maintenance practices.

3.1.1 B - Design Causes:

- Weak foundation
- Failure of structural elements (foundation, beam, slab and column)
- Quackery or none involvement of construction professionals
- Disregard for soil condition or lack of conduct of geotechnical investigation
- Client and Contractor’s penchant to cut corners/cost and/or maximize profit.
- Poor Building maintenance practices.

3.1.1 C - Construction Causes:

- Use of sub-standard or poor-quality construction Materials
- Poor workmanship and lack of or inadequate supervision
- Weak foundation
- Improper anchorage of reinforcements
- Lack of adherence to design specifications for reinforcements, concrete etc

- Quackery or none involvement of construction professionals
- Building without the required regulatory approvals for design and construction or contravention of approved building plans.
- Use of technically deficient building contractors
- Disregard for soil condition or lack of conduct of geotechnical investigation
- Client and Contractor’s penchant to cut corners/cost and/or maximize profit.
- Lack of or poor safety measures e.g. unauthorized storage of explosives.’
- Violation of stop work order.
- *Force Majeure* – Rainstorm and other natural disasters.

3.1.1 D – Post-design Causes:

- Illegal conversion of Buildings or unauthorized building modifications
- Poor Building maintenance practices.
- Lack of or poor safety measures e.g. unauthorized storage of explosives.’
- Violation of stop work order.
- *Force Majeure* – Rainstorm and other natural disasters.

3.2 Ranking of the Identified Causes of Building Collapse In FCT: 2008 – 2024.

Table 2 presents ranking where the use of substandard material emerged as the leading cause of building collapse and natural disaster emerged as the least cause of Building Collapse in the FCT agrees with the findings of Nicholas *et al.* (2021).

Table 2.: Ranking of the Identified Causes of Building Collapse in FCT: 2008 – 2024.

S/No.	Cause	No. of Occurrence	Percentage of occurrence (%)	Position
1	Use of Substandard/poor quality Materials	9	26.470	1st
2	Structural failure including Under-reinforcement/Improper anchorage of reinforcement	5	14.710	2nd
3	Lack of or poor Supervision/Poor workmanship	3	8.824	4th
4	Poor Concreting	2	5.882	6th
5	Use of quacks/quackery/use of unqualified professionals	4	11.765	3rd
6	Violations of Building Regulations/approvals	2	5.882	6th
7	Illegal conversion of buildings/addition of floors	2	5.882	9th
8	Lack of Geotechnical Investigation/Low Soil bearing capacity/Weak and/or Inappropriate foundation	3	8.824	4th
9	Poor Safety and Maintenance practices	-	-	-
10	<i>Force Majeure</i> /Rainstorm/other natural disasters	1	2.940	9th
11	Landslide	2	5.882	6th
12	Partial/incomplete demolition	1	2.940	9th
Total		34	100	

In comparison to the finding of Omenihu *et al.* (2016), Substandard materials accounts for the second leading cause of building collapse in Nigeria while the findings of this study established substandard materials as the leading cause of building collapse in the FCT. This shows that the leading causes of building collapse vary slightly from one city to the other.

A total of thirty (30) incidences of building collapse were recorded in the FCT since the first reported occurrence in 2008 leaving more than fifty-four (54) persons dead and several others injured. According to

Akuboh (2019), the FCT accounts for the second highest occurrence of building collapse incidents in Nigeria after Lagos.

3.2.1 Occurrences of Building Collapse by Year in FCT - Abuja

Table 3: Occurrences of Building Collapse by year in FCT - Abuja

S/No	Year	No. of Occurrence
1	2008	1
2	2009	2
3	2010	2
4	2011	2
5	2012	4
6	2013	3
7	2014	1
8	2015	0
9	2016	3
10	2017	0
11	2018	1
12	2019	0
13	2020	1
14	2021	0
15	2022	1
16	2023	3
17	2024	6
Total		30

3.3 Ranked Causes of Building Collapse in the F.C.T Explained:

Use of Substandard/Poor Quality Materials: The impact of inflation, fluctuating foreign exchange rates and rising cost of building materials such as cement, steel reinforcements and concrete products over the years in Nigeria has led to the use of substandard and recycled materials at the detriment of structural safety and stability. The penchant to cut corners and make profits can also not be ruled out as one of the reasons for the use of sub-standard building materials by contractors.

Structural failure: Structural members such as Slab, column, beam or cantilevers fail due to reasons such as use of sub-standard materials, improper anchorage of reinforcements, use of inappropriate or inadequate reinforcement sizes, lack of or inadequate supervision of concrete placement works, violation of technical specifications and approved designs and overloading amongst others.

Lack of or Poor Supervision/Poor Workmanship: Lack of qualified technical personnel to supervise construction works and poor workmanship by workmen contribute a great deal to the incidences of building collapse.

Poor Concreting: Inappropriate concrete mix ratio and water-cement ratio are parameters that determines the quality and effectiveness of a concrete mix. If the quality of concrete mixes are not monitored for compliance and consistency, it will most likely jeopardize the structural integrity of buildings over time.

Use of quacks/quackery/use of unqualified professionals: The quest for cheap labour and rising unemployment has contributed a great deal to the use of unqualified professionals and the proliferation of quacks in building construction. This development if left unattended to has negative effects on the fight against building collapse in Nigeria.

Violations of Building Regulations/approvals: Building regulations are a set of rules and guidelines that govern the construction and maintenance of buildings. Compliance with these regulations is critical to ensure safety, accessibility, and quality of life for occupants. Unfortunately, building regulation violations are all too common, and they can result in significant penalties, legal action, and even loss of life. A common example of the violation of building regulation is lack of conduct of final inspection and occupation of a building without certificate of fitness for human habitation.

Illegal conversion of buildings/addition of floors: Unauthorized modification of approved building plans and illegal addition of floors constitutes a major problem resulting in the collapse of most buildings.

Lack of Geotechnical Investigation: Soil investigation is a pre-requisite for design of suitable foundation for buildings. Lack of soil investigation therefore could lead to the use of wrong foundations and subsequently structural instability.

Force Majeure/Rainstorm/other natural disasters: The forces of nature are also a cause of building collapses. This entails events that man has no control over and they are termed as “*force majeure*”. They include windstorm, torrential rain, earthquake, earth tremor, landslide, flooding etc.

4. Conclusion

Incidences of Building collapses in Nigeria have no doubt led to the untimely deaths and loss of properties and investments of inestimable value even though many of such cases might have occurred unnoticed or unreported. A total of thirty (30) building collapses were identified to have occurred in FCT Abuja from 2008 to 2024 with the leading causes of the occurrence determined as use of sub-standard material, structural failure, quackery, lack of conduct of geotechnical investigation and lack of or inadequate supervision/poor workmanship. Having identified the leading causes of building collapses in Abuja, Nigeria, prevention is the ultimate solution.

The recommendations arising from this study are presented in accordance with the ranking of the causes of building collapse in the FCT.

Use of Substandard Materials (Nicholas et al., 2022):

- i. Standard organization of Nigeria, (SON) should monitor the standard of blocks moulded-in block industries and impose minimum standards in terms of sand-cement ratios and scrutinize building materials that are supplied for use in Nigeria and ensure that only certified building materials are allowed in the market.
- ii. The standard organization of Nigeria should be vigilant to ensure that building materials imported into the country conform to standard requirements.
- iii. There is a need to empower and restructure materials testing laboratories in all Geo-political zones of the country.
- iv. Building professionals and contractors should ensure proper and efficient checking of materials brought to site and carry out tests such as cube test for concrete, tensile strength for steel bars, slump test for in-situ concrete in a building project following Engineer’s specification.
- v. The design team in any building project should ensure that building materials supplied to the site by the domestic or nominated supplier are under the contract specification.
- vi. The national regulations regarding building materials are revised and consider the international standards to be adopted.
- vii. Build on tested engineering properties of available local building materials in Nigeria.

Structural Failure (Nicholas et al., 2022):

- i. There is a need to organize periodic public awareness campaign through electronic and print media to sensitize the public on the advantages of using professionals as a way of realizing safe buildings. Civil/Structural Engineers should be engaged in all building construction projects up to and above one suspended floor.
- ii. The building construction process involves professionalism in the planning, design, and execution of the project. Engineering consultants must be involved in the design and supervision of buildings
- iii. Imposing additional floors beyond original design provision should be avoided.
- iv. Reduce the level of exposure of structures to risk by imbibing maintenance culture, seek advice from experts when changing the form and use of buildings, and insist on material and soil tests for multistorey buildings.
- v. Regulatory professional bodies such as the Engineering Regulatory, Monitoring and Enforcement (ERM&E) unit of COREN and their corresponding associations should on regular basis organize workshops for stakeholders in the building industry to update their knowledge and highlight the dangers and penalties associated with collapsed buildings.

Lack of or Poor Supervision/Poor Workmanship:

- i. All stages of building construction must be properly and adequately supervised by the requisite professional member of the built environment to ensure compliance to design specifications and acceptable construction methods.
- ii. The works carried out by the workers on site also need to be closely monitored by the professionals to ensure quality of construction.

Poor Concreting:

- i. There is a need to ensure proper mix of concrete before placement.
- ii. Long, flat aggregates should be avoided as much as possible as they tend to have less grip in concrete and have a tendency towards segregation during handling. Shape and texture of coarse aggregates affects the strength of the concrete mix.
- iii. Cubical aggregate has maximum strength in concrete as it has good packing and strength in all direction. Rounded aggregate is not suitable for concrete

Use of quacks/quackery/use of unqualified professionals ((Nicholas et al., 2022):

- i. All building professionals play key roles to actualize their respective obligations during building production, using the wrong professionals at any stage of the building process puts the building in danger.
- ii. Construction should involve the collaboration of different professionals who have been registered by law practice the art of the building process.
- iii. Only workers or building operatives with the appropriate training and experience should be allowed to engage in building works especially on the structural members.

Violations of Building Regulations/approvals:

- i. Building Regulatory Authorities should ensure strict enforcement of building regulations such as inspection and issuance of certificate of fitness for human habitation for completed buildings.
- ii. Building Regulatory Authorities should also ensure that the necessary setbacks from roads, electricity supply lines and property lines are observed in building designs and when setting out buildings for construction.
- iii. Building Regulatory Authorities should also ensure that the purpose of building use are not changed arbitrarily too.

Illegal conversion of buildings/addition of floors:

- i. The number of suspended floors of a building is a function of the geotechnical properties of the underlying soil strata. This underscores the approval for a particular number of suspended floors or storey. However, alteration or addition of the number of suspended floors without recourse to the soil bearing capacity and revalidation by the authorities has been one of the factors responsible for many incidences of building collapse in Nigeria. All proposals for increase of number of suspended floors must be subjected to expert advice and submitted to Building Regulatory Authorities for vetting prior to any action.
- ii. The conversion of buildings from residential to commercial or any other use contrary to the approved use is illegal and should be avoided as much as practicable.

Lack of Geotechnical Investigation:

The Geotechnical properties of the soil and the nature of the proposed building is a determinant of the type of foundation to be adequately designed and provided. The conduct of geotechnical investigation is therefore of utmost importance.

Force Majeure/Rainstorm/other natural disasters (Nicholas et al., 2022):

- i. Building on flood plains or flood-prone areas should be avoided because flood weakens soil structure and foundation.
- ii. Building on the hillside is likely to collapse due to erosion. Ensure that the soil surrounding the building is well protected with concrete or with stone pitching. All stakeholders in the construction industry should adhere strictly to the provisions of the building code.

References

- Akuboh, DO. 2013. Causes of Building Collapse in Nigeria...towards enduring remedial measures, *The Abuja Engineer, A Publication of the Nigerian Society of Engineers Abuja. 5th Edition, August. Pp. 21 – 23.*
- Akuboh, DO. 2019. The Menace of Building Collapses in Nigeria – The Way Forward, A paper presented at the Public Lecture of the Nigerian Institution of Civil Engineers (NICE), Jalingo Chapter in Collaboration with the Nigerian Institution of Civil Engineers (NICE), Abuja Chapter, Jalingo, Taraba State. 11th July, 2019.
- Ayinuola, GM. and Olalusi, OO. 2004. Assessment of building failure in Nigeria, *African Journal of Science and Technology. 5(1): 73-78.*

Edighoman IE. 2016. Cost Avoidance as a Major Culprit for Building Collapse in Nigeria - The Quantity Surveyors Intervention. A Paper presented at the 6th Building & Construction Economic Round Table (BCERT 6). Shehu Musa Yar'adua Centre, Central Area, Garki, Abuja, 14th to 15th July, 2016.

Federal Republic of Nigeria, 2006. National Building Code, 1st Edition. Lexis Nexis, Butterworths, South Africa.

Furman, T.T, 1981. Approximate Methods in Engineering Design. Mathematics in Science and Engineering vol.155 (ED) Richard, Bellman, Academic press, pp. 123-132

Ketkukah, S.T, 1998. Progressive Structural failure Analysis of plane trusses. M.Sc Thesis, Ahmadu Bello University (ABU) Zaria, Unpublished.

Lampthey-Puddicombe, AD. 2016. Preventing Building Collapse in Nigeria: The Role of Professionals. A paper presented to the Quantity Surveyors Registration Board of Nigeria (QSRBN) on the 6th Building and Construction Economic Round Table (BCERT) on the theme: professional issues and challenges in building collapse in Nigeria. Abuja. 14th & 15th July, 2016.

Lawal, PO. 2016. An Overview of the Economic and Social Costs of Building Collapses in Nigeria. A paper presented to the Quantity Surveyors Registration Board of Nigeria (QSRBN) on the 6th Building and Construction Economic Round Table (BCERT) on the theme: professional issues and challenges in building collapse in Nigeria. Abuja. July, 2016.

Matawal, DS. 2013. Experts Proffer Permanent Solution to Building Collapse. Retrieved from <http://www.nigerianbestforum.com/index.php?PHPSESSID=d107973e0bb5c9a064c00b09ef5fa9e0&topic=216715.msg519689#msg519689> 16th April

NBRRI Technical Report No. 22: Collapse of Buildings in Nigeria (Technical Report on the Collapse of a @-Storey Building at Mararaba. October, 2011.

NBRRI Technical Report No. 23: Collapse of Buildings in Nigeria (Technical Report on the Collapse at Adenubi Close, Ikeja, Lagos State. October, 2011.

NBRRI Technical Report No. 26: Collapse of Buildings in Nigeria (Technical Report on a Collapsed Building in Ilorin, Kwara State. July, 2012.

NBRRI Technical Report No. 29: Collapse of Buildings in Nigeria (Analyses of Collapse of Two-Storey Building at Kubwa Extension III. December, 2012.

NBRRI Technical Report No. 36: Collapse of Buildings in Nigeria (Technical Report on Collapsed School Building at Abu Ni'ima Islamic School, Bukuru, Jos, Plateau State. February, 2016.

NBRRI Technical Report No. 45: Collapse of Buildings in Nigeria (Technical Report on the Collapse of three-Storey Faculty of Social Sciences Building, Benue State University, Makurdi, Benue State. February, 2019.

NBRRI Technical Report No. 47: Collapse of Buildings in Nigeria (Technical Report on the three (3) Storey Collapsed Building under construction at Jabi District, Abuja. September, 2018.

NBRRI Technical Report No. 51: Collapse of Buildings in Nigeria (Technical Report on the Collapsed 8-Storey Building under Construction at Umaru Yar' Adua Drive, Owerri, Imo State, Nigeria. June, 2020.

Nicholas, IO., Nwalusi, MD., Francis OO. 2021. Building Collapse in Nigeria and its Consequences on the Architect's Role as the Leader of the Building Team. Jordan Journal of Earth and Environmental Sciences (JJEES) (2022) 13(1): 16-25.

Olusola, KO., Ojambati TS. and Lawal AF. 2011. Technological and Non-Technological Factors Responsible for the Occurrence of Collapse Buildings in South-Western Nigeria, Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 2(3): 462-469.

Omenihu FC., Onundi LO. and Alkali MA. 2016. An Analysis of Building Collapse in Nigeria (1971 – 2016): Challenges for Stakeholders. University of Maiduguri, Annals of Borno, Volume XXVI, June, 2016.