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Identification, Classification and Ranking of the Causes of Building Collapse in Lagos, Nigeria from 2012 to 2024

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ABSTRACT

The incidence of building collapse in Nigeria has continued unabated, leading to the loss of lives, injuries, loss of properties, investments, and future commissions. This frequency of occurrence plummets in cities with a propensity for vertical developments and several causes ranging from the use of substandard construction materials and illegal conversion of buildings to failure of key structural elements. This work examined the incidences of reported building collapses in Lagos, Nigeria, from 2012 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. 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. This has undoubtedly led to increased research interest in the subject matter of building collapse in Nigeria. Findings of this study revealed the leading causes of building collapse in Lagos in decreasing order to include primary failure of key Violation of building regulations/approvals, distressed buildings marked for demolition, torrential rainfall/rainstorm/thunderstorm & secondary failure, structural failure including under-reinforcement/ improper anchorage of reinforcement and structural defects, and illegal conversion of buildings/addition of suspended floors/illegal renovation. A total of 106 cases of building collapses were identified to have occurred in Lagos within the period under consideration with average frequency of occurrence of 49.89%, leading to the confirmed death of at least 357 persons from 2012 to 2024 alone. It was comparatively established that the leading causes of building collapse in Nigeria vary from one place to the other. Recommendations were made in line with the evaluated leading causes of building collapse in Lagos in accordance with the stages of building and structure of the National Building Code.

Keywords: Building, Building Collapse, failure, Causes, Death, Ranking.

1. Introduction

Building collapses occur 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 it has reached the limit state conditions and not necessarily when the imposed load cannot be supported by the foundation. 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 occasioned by one or a combination of defective key structural elements, shear, excessive deflection, buckling, spalling exposing rebars to corrosion and excessive vibration is referred to as building collapse, while the planned falling of a building is referred to as demolition.

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 noticeable cracks which become widened with time or unusual sound in the building due to structural members gradually giving way. In the sudden collapse scenario, the building falls down 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 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.

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 sources of data and methodology for this study were derived from a review of selected literature, technical reports, the author's independent records, and online news articles, with data analysis conducted using simple descriptive statistics, counts/frequency of occurrence, rankings, and percentages. The objectives of this study are to ascertain the number of building collapses that occurred in Lagos, Nigeria, from 2012 to 2024, evaluate and rank the suspected causes of the building collapses, and adduce these causes according to the stages of building development outlined in the National Building Code.

Many publications have been made on building collapse in Nigeria. In these publications and available data, Lagos takes the lead in this menace and that is why this paper is dedicated to examining the occurrences in Lagos and evaluating their possible causes. It is important to first of all have a review of why failure occurs using the bath-thub curve as an example. The Bath-Tub Curve or Lusser Mortality curve established in 1952 by Robert Lusseras the first statistical theory of reliability (Furman, 1981) below illustrates the three failure rates of all components and equipment which follows a certain basic pattern viz: 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.

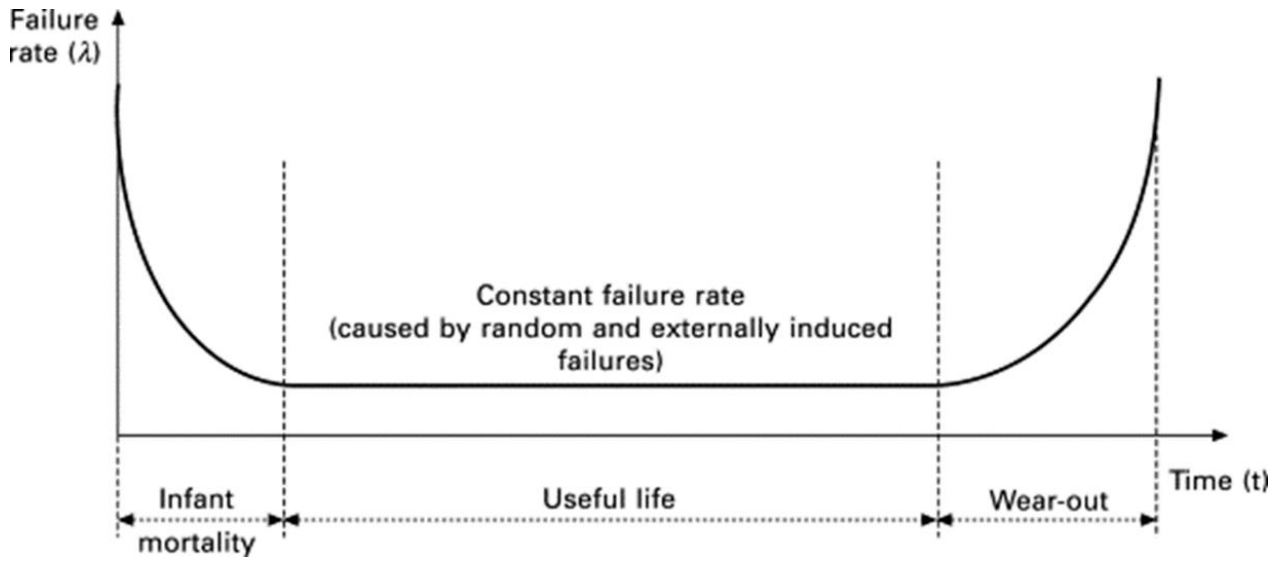

Figure 1: Lusser Mortality Curve (Furman, 1981

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 failures are typically caused by manufacturing flaws or damage received during transit or handling. The operating period that follows infant mortality is characterized by a smaller, relatively constant failure rate until the wear-out period begins. Failures during the operating period are usually due to chance, often resulting from severe, unpredictable, and usually avoidable stresses such as environmental factors like vibrations, temperature, shock, human errors, and pressure. Upon reaching the wear-out period, the failure rate tends to increase rapidly due to the gradual degradation of system properties essential for proper functioning, such as resistance to corrosion and abrasion (Furman, 1981).

Globally, the causes of building collapse are either natural, such as rainstorms, earthquakes, earth tremors, landslides, windstorms, or flooding, or man-made (Akuboh, 2013). A review of news articles and technical reports reveals specific causes of building collapse, including improper concreting, sudden or partial collapse, structural failure, heavy rainfall, unequal foundation settlement, faulty foundation design, and the collapse of adjacent buildings or fence walls. Additional causes include the premature removal of formwork for roof slabs or concrete decking, the use of substandard materials without government approval, poor workmanship and supervision, inadequate roof and floor slab bracing, the use of buildings that have not achieved their minimum allowable strength, gas explosions, distressed buildings, illegal addition of floors, roof gutter failure, and the tendency of clients or contractors to prioritize cheap labor and cost-cutting.

The findings of Omenihu et al. (2016) highlight the leading causes of building collapse in Nigeria. These include structural failures (24.9%), substandard materials (13.2%), poor workmanship (12.2%), faulty design (8.8%), the use of unqualified personnel (7.3%), and inappropriate foundation design (6.8%). These findings align with investigations conducted by the Nigerian Building and Road Research Institute (NBRRI), as

documented in several NBRRI reports. A recurring theme in these investigations is that substandard materials and poor workmanship, often stemming from inadequate supervision, significantly contribute to building collapses.

The effects of building collapse can be devastating and far-reaching. According to Lamptey-Puddicombe (2016), these effects include loss of life, property, and substantial capital, alongside reputational damage and psychological trauma. Further consequences include the loss of new commissions and contracts, damaged components and materials that are beyond reuse, and irrecoverable capital investments. Such incidents often lead to bankruptcy and have significant economic implications for the nation's economy.

Figure 2: 21 Storey Building Collapse, Ikoyi, Lagos _ 1st November, 2021

Figure 3: Rescue Operations at the site of a two (2) Storey Building Collapse at Agege, Lagos – 31st March, 2018.

2. Materials and Methods

The data used in this review were obtained from the independent records of one of the authors (Akuboh, D.O),obtained through Television news, Newspaper articles, online sources/Internet, Conference proceedings of the Quantity Surveyors Registration Council of Nigeria (Edighoman I.E., 2016), some Investigative Reports of the National Building and Road Research Institute (NBRRI) on Building Collapses between 2012 and 2024. The research methodology flow chart of Nicolas et al., 2021 as contained in Figure 4 was adopted in carrying out this study.

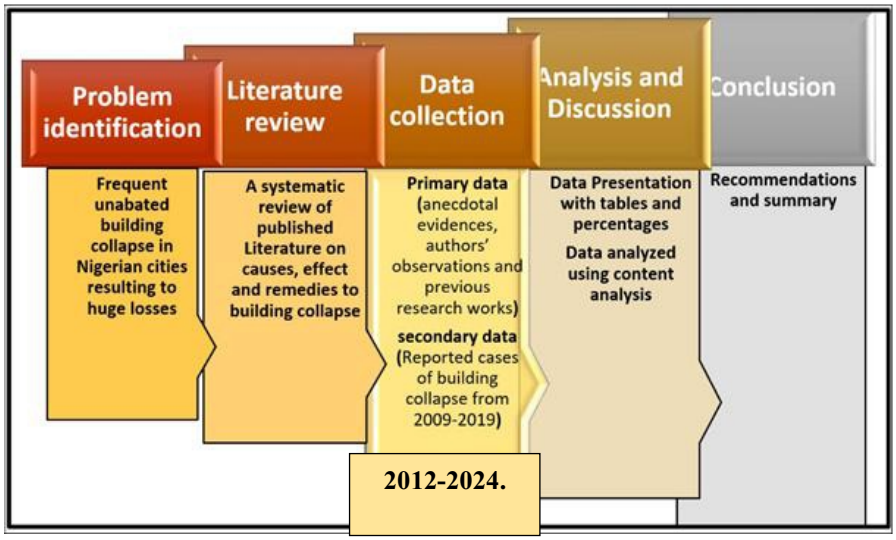

Figure 4: Research Methodology Flow Chart (Nicholas *et al.*, 2021)

3. Results and Discussion

Table 1 is a detailed report of building collapses in Lagos, Nigeria, compiled by the authors for the period of 2012 to 2024. It presents the recorded incidents of building collapses, along with the identified causes, highlighting their frequency and nature during this timeframe.

Table 1: Record of Reported Building Collapses and Their Identified Causes in Lagos (2012-2024)

S/N	Building Type	Address	Date of Occurrence	Casualties		Suspected Cause/Time of Occurrence
				Death	Injuries	
1	Guest Chalet	2, Community Street, Ita-Baale, Bariga, Lagos.	29th June, 2012	1	1	Collapse of Neighbouring Building Fence wall as a result of heavy rainfall
2	3 Storey Building	3,Anikantamo Street, off Adeniji Adele Road, Lagos.	31st July, 2012	0	1	Heavy Down Pour
3*	3 Storey Building	Saliu Ariyo Street, Lafiaji, Lagos	6th August, 2012			Partial Collapse
4	2 Storey Building	Block M20, Jakande Estate, at Church Street, Oke-Afa,Isolo, Lagos.	21st November, 2012	2	1	Noticeable Wall Cracks occasioned by uneven settlement
5	3 Storey Building	Oloto Street, Ebute-Meta, Lagos.	2012	10		Partial Collapse
6	A Building	174, Corporation Drive Dolphin Estate, Ikoyi Lagos	November, 2012	0		Structural Failure
7	5 Storey Building Under Construction	9, Muri Okunola Street, Victoria Island, Lagos.	4th November, 2013	4	50 Trapped (25 Rescued)	
8	3 Storey Building	16, Alli Street,Tinubu, L/Island,Lagos.	25 Sept, 2013	3	10 Injured	Distressed Building
9	Bungalow	13, Alli Street,Lagos.	25 Sept, 2013			Collapse of Adjacent Building
10	3 Storey Building Marked for Demolition	Ebute Meta, Lagos.	May, 2013	7	10 Trapped	

11	3 Storey Building	No. 353, Challenge Road, off Amu Street, in Mushin, Lagos	12th June, 2013	1	Several	
12	2 Storey Building under Construction	32/36, Ishaga Road, Surulere, Lagos	21st July, 2013	4	3	Heavy Downpour
13	1 storey Residential Building under construction	Godo Blocks Estate, Ibereko in Badagry, Lagos State	18th May, 2013	1	2	Sub-standard Materials and premature removal of concrete slab/decking formwork
14	3 Storey Uncompleted Building	Lateef Rufai Way, Liverpool Zone 2 Estate, Satellite Town, Lagos	11th May, 2013	2		
15	A Storey Building	9, Shogbemu Street, Bariga, Lagos.	May, 2013	1	2	
16	3 Storey Building	6, Adenaike Street, Ejina area, Ikorodu, Lagos	May, 2013	2		Caving in of Building marked for demolition
17	4 Storey Building	24, Bashiru Street, Isheri Area, Ojodu-Berger, Lagos	8th May, 2013	2	4	
18*	4 Storey Building	Isalegangan, Lagos Island	15th May, 2013			Total Collapse
19*	3 Storey Building	Isalegangan, Lagos Island	21st March, 2013			Total Collapse
20*	3 Storey Building	No. 34, Salami Street, Okepopo, Lagos	19th July, 2013			Patial Collapse
21*	4 Story Building	Shagamu Oroyinyin, Lagos Island	25th August, 2013			Partial Collapse
22	6 Storey Hostel Collapse at Synaguoge Church of All Nations	Ikotun, Lagos	12th September, 2014	116	85 deaths were South Africans, Over 100 Injured.	Faulty Foundation
23	A Warehouse at Synagogue Church	Ikotun Egbe Area of Lagos State, Nigeria	September, 2014	4		Demolition Process
24*	4 Storey Building	Isale-Eko, Lagos Island	24th June, 2014			Partial Collapse
25	Section of 2 Storey Police Barrack	Pedro Police Barracks, Shomolu, Bariga, Lagos	1st July, 2014	0	40	Partial Collapse
26*	4 Storey Building	John Street, Idumota, Lagos Island	6th July, 2014			Total Collapse
27	3 Storey Building	Bucknor Estate, Jakande, Isherioshun Road	July, 2014			Structural Failure
28*	4 Storey Building	Ejigbo/Isolo Lagos State 35b, Seriki Street, Isale-Eko, Lagos	2014			Total Collapse
29	5 Storey	Commercial Avenue, Yaba, Lagos	11th March, 2015	0	4 Rescued	
30	4 Storey Building	6, Mogaji Street, Idumota Lagos Island	March, 2015			Undisclosed
31	4 Storey Building Under Construction	38, Commercial Avenue, Sabo, Yaba, Lagos	9th July, 2015	0	0	
32	3 Storey	29, Oloto Street, Ebute Meta, Lagos	15th July, 2015	0		Deserted Building Marked for demolition which partially collapsed in 2012
33	3 Storey	87, Swamp Street, Odunfa, Lagos Island	21st October, 2015	1	4 trapped	
34	Private Residential	19b, HFB Way, Dolphin Estate, Ikoyi, Lagos	18th April, 2015	0	4	Gas Explosion
35*	3 Storey Building	77, Aroloya Street, Epetedo, Lagos	2015			Partial Collapse
36*	3 Storey Building	Ikepopo, Lagos Island	March, 2015			Total Collapse
37*	4 Storey Building	Ikepopo, Lagos Island	May, 2015			Total Collapse
38	5 Storey Building at Lekki (Lekki Gardens)	Ikate, Lekki Phase 1, Lagos	8th March, 2016	35	Several injured. 13 recued alive	Poor Quality of Construction Materials, workmanship and supervision. Increase in number of floors from 3 to 5.

39	3 Storey Building	Ojodu Lagos	May, 2016	2		Undisclosed
40	2 Storey Building	Mile 12, Lagos	March, 2016	1		Structural Defects
41	2 Storey Building	Lekki, Lagos	March, 2016			
42	2 Storey Building Under Construction	21, Makinde Street, Alausa, Ikeja, Lagos	15th December, 2016	0	1	Structural Defects
43	2 Storey Residential Building	Highway Police Barracks in Ikeja, Lagos State	25th December, 2016	2	11 injured	
44	2 Storey under construction (Partial Collapse)	NICON Town Estate, Off Admirality Way, Lekki, Lagos State	28th April, 2017	3	4	Partial Collapse triggered by Roof Gutter Failure.
45	3 Storey Building Under Construction	2/4 Richard Abimbola Street off Limca Road in Ire, Akari Estate, Isolo Area of Lagos State.	17th May, 2017	3	Many trapped/ injured, 19 rescued	
46	3 Storey Residential Building Under Renovation	15, Daddy Alaja Street in Oke-Arin, Idumota, Lagos. Island in Lagos.	29th May, 2017	2	14 Injured	
47	4 Storey Residential Building	No 3 Massey Street, Lagos Island.	25th July, 2017	6	16 Rescued	Addition of 4th floor to an existing 3 storey was done. Immediate cause unknown.
48	Bungalow	No 7, Saidu Okeleji Street, Alaro, Meran, Abule Egba, Lagos State.	22nd July, 2017	2	Nil	
49	4 Storey Building	Lagos.	26th July, 2017	8		
50	3 Storey Building	No. 21, Saka Okoro Street, Ilufe Road, Alaba International Market.	29th August, 2017	0	0	Distressed Building
51	One storey Building	9, Abeje Street, Morikaz Road, Agege, Lagos.	31st March, 2018	2	Many	Distressed Building Marked for Demolition
52	Two Storey Building	Olushi Street, Lagos Island, Lagos.	6th August, 2018	0	0	
53	3 Storey Building	Lagos Island	February, 2019			Undisclosed
54	3 Storey Residential/School Building	14, Massey Street, Ita Faji area of Lagos Island.	13th March, 2019	20	43	
55	A Building	57, Egerton Square in Oke-Arin area of Lagos Island.	18th March, 2019	0	4	Demolition gone wrong
56	3 Storey Residential Building	Kakawa street, Lagos Island.	25th March, 2019	0		
57	A Bungalow	Kakawa street, Lagos Island.	26th March, 2019	0	0	Secondary failure. Effect of Collapse of adjacent 3 Storey Building.
58	Three (3) Storey Building	Agaruwa, Lagos Island, Lagos.	28th May, 2019	1		Distressed Building Marked for Demolition
59	One (1) Storey Building Under Construction	Kayode Aluko Olokun Close, Shangisha, Magodo, Lagos.	13th June, 2019		3	
60	Two (2) Storey Building Under Renovation	No. 36 Adesanya Street, Mafoluku, Oshodi, Lagos State.	23rd June, 2019		2	Secret Renovation of Old Building
61	Three (3) Storey Building Under Construction	K-Farm Estate, Fagba, in the Iju area of the Ifako-Ijaiye Local Council Development Area, Lagos State.	27th June,2019		12	Use of quacks and sub-standard building Materials.
62	Three (3) Storey Building	Osasa area of Bariga, Lagos State.	28th July, 2019		6	

63	Two (2) Storey Building	Gbagada, Lagos.	1st August, 2019			
64	A Building	Orisha Communty, Magodo-Isheri area of Lagos.	12th October, 2019	4	6	Building on a Hill Collapsed on Adjacent Buildings
65	A Building	Rademo Street, behind Recreation Center, Ita Elewa, Ikorodu, Lagos	12th October, 2019	0	0	
66	Storey Two (2) Building	No 7, Rufai Street, Ojuelegba, Lagos.	24th October, 2019	0	0	Distressed Building Marked for Demolition
67	Two(2) Storey Building	Ikoyi, Lagos.	30th October, 2019	4	1	
68	3 Storey Building Under Construction	Ago Palace Way axis of Lagos State.	17th January, 2020	0	1	
69	3 Storey Building	6, Olonode Street, Ebute Metta, Lagos.	25th May, 2020	0		Weak Structural Members
70	A Storey Building	46, Gafari Balogun Street, Ogudu, Lagos.	17th June, 2020	2		Heavy Down pour
71	2 Storey Building	92, Freeman Street, Lagos.	11th July, 2020	3	9	Total Collapse
72	1 Storey Building	No 46, Gafari Balogun Street, Ogudu Area Of Lagos State	22nd July, 2020			Heavy Rainfall
73	3 Storey Building	Cemetery Street, Ebute Metta, Lagos	24th July, 2020	0		Distressed Building
74	3 Storey Building	5, Ansarudeen Street, Ile-Epo Bus Stop, Lagos State	19th September, 2020			Distressed Building
75	2 Storey Building Under Construction	77, Tapa Road, OkeOjoIsawo along Ikorodu, Lagos.	20th July, 2021	1		Collapsed at about 2:20pm.
76	2 Storey Building	97, Lagos Road, Haruna Area, Ikorodu, Lagos	18th October, 2021	1	3	Collapsed at about 10:00PM.
77	21 Storey Building Under Construction	Gerrald Street, Ikoyi, Lagos.	1st November, 2021	46	15	Illegal addition of 6 floors
78	2 Storey Building	Osapa London area of Lekki, Lagos.	2nd November, 2021			
79	1 Storey Building (Under Construction)	Sunny Filled, Flour Mills, Estate, Magbon, Badagry,Lagos.	17th November, 2021	4	5	Bungalow Conversion gone wrong, Inadequate reinforcement rod diameters, use of obsolete old reinforcement rods.
80	3 Storey Building	Akunde Crescent, Onike, Yaba, Lagos.	12th February, 2022			Use of sub-standard material and violation of stop work order
81	3 Storey Building Under Construction	No. 16 Akanbi crescent, off Adesina Street, Harvey, Sabo, Yaba, Lagos.	13th February, 2022	5		Violation of Stop work order and breaking of government seal.
82	3-Storey Building	Ibada Street, Ebute-Meta, Lagos.	1st May, 2022	10	23	Collapsed at about 09.30pm.
83	2 Storey Building	Cris Igade Street, Off Ago Palace Wary, Opposite Kilomanjaro/AP, Lagos State.	7th May, 2022	0		Building Failed Integrity test and Marked for Evacuation
84	3-Storey Building Under Construction	Freeman Street, Lagos Island.	21st May, 2022	4	5	

85	3-Storey Building	4, Alayaki Lane, Lagos Island.	May, 2022	2		
86	2-Storey Building	15, Oke Arin, Off Shyllon Illupeju, Inipanu Area, Lagos. .	13th July, 2022	0	1	Collapsed at about 12.45AM.
87	A Bungalow	Adeleye Street, Lady Lark, Bariga area of Lagos State.	21st August, 2022	2	3	
88	7 Storey Building Under Construction	Oba Idowu Oniru Street, Beside Avi Maria Hospital, Lekki, Lagos	4th Sept., 2022	3	6	
89	3-Storey Building	Oyesonuga Street, Palm Avenue, off Oye Roundabout, Isolo Mushin Local Government Area of Lagos State	23rd Sept., 2022	4	3	Collapsed at bout Mid-day.
90	A Storey Building	No.12, Aromire Avenue, Oppt. Domino Pizza, Ikeja, Lagos.	18th January, 2023	1		
91	2 Storey Abandoned Building	Olokodana Street, Okokomaiko, Lagos	22nd January, 2023	0		
92	7 Storey Building Under Construction	First Avenue, in the Banana Island area of Ikoyi, Lagos.	12th April, 2023	0	8	
93	3 Storey Building Under Construction	No. 43B, Ladipo Oluwole Street, GRA, Apapa Lagos.	23rd April, 2023	0		Torrential Rainfall/Thunder
94	2 Storey Building	Ijegun, Lagos	24th Sept., 2023			
95	800 Room Apartment	Ketu, Lagos	23rd Sept., 2023			
96	4 & 2 Storey Building located side by side	47/49, Oduntan Street, Kosofe Local Government Area of Lagos State.	17th Sept., 2023		1	School turned Residential Building with 500 Rooms
97	2 Storey Building with Penthouse	Herbert Macauley Way, Ebute-Meta, Lagos	22nd December, 2023	2	0	Violation of Evacuation Notices
98	3 Storey Building	24, Binuyo Street, Off Ita Faaji Market, Lagos Island. Local Government Area, Lagos State	22nd February, 2024			Rain storm, Building marked for vacation
99	Balcony of a 3 Storey Building	5, Fanny Street, Ita-Faaji, Lagos Island.	23rd April, 2024	1	3	Partial Collapse
100	2 Storey Building	Dosumu/Idumota Market, Lagos Island, Lagos	9th April, 2024		10	Fire Incident/Inferno
101	2 Storey Building (Mosque)	Papa Ajao, Ladipo, Mushin, Lagos	26th May, 2024	3	7	Mosque that was hit by an Excavator (An Accident).
102	4 Storey Building	Idungaran, Close to Oba's Palace, Lagos Island, Lagos.	30th May, 2024		9	
103	2 Storey Building	12, Cameroon Street, Off Ewenla Street, Mushin, Lagos.	2nd July, 2024	0	7	

104	Collapse of a Boys Quarters Building	No. 49, Oyinlola Street, Off Adelabu Bus Stop, Iyana Ipaja, Lagos, Lagos State.	13th July, 2024	0	0	Torrential Rainfall
105	3 Set of Terrace Building (Uncompleted Building)	No. 13, Wilson Mba Street, Arowojobe Estate, Maryland, Lagos	25th July, 2024	3	3	
106	2 Storey Building	20, Amusu Street, Off Bale Bus-Stop, Orile-Iganmu, Surulere, Lagos	14th October, 2024	0	0	
		TOTAL		357	Many	

3.1 Classification of the Causes of Reported Building Collapses in Lagos, Nigeria.

Based on the findings presented in Table 1, which details the investigation reports of building collapses in Lagos, it can be deduced that the primary causes of these collapses are often linked to inadequate supervision of labour, materials, and construction methods, as well as secondary failures resulting from prior incidents. Pre-design causes involve buildings constructed without the necessary regulatory approvals or in contravention of approved plans, alongside poor maintenance practices. During the design phase, weak foundations, structural defects in elements like foundations, beams, slabs, and columns, and the absence of qualified construction professionals contribute significantly to failures. The disregard for soil conditions and failure to conduct geotechnical investigations also play a role. In the construction phase, the use of substandard materials, poor workmanship, and lack of adequate supervision are key contributors. Structural defects and weak foundations continue to be prevalent, and unprofessional demolition practices and improper anchorage of reinforcements add to the risks. Additionally, failure to follow design specifications for reinforcements and concrete, along with the use of technically deficient contractors and unauthorized modifications without regulatory approvals, exacerbate the situation. Clients and contractors cutting corners to reduce costs or maximize profits, as well as inadequate safety measures, such as unauthorized storage of explosives, further complicate matters. Violations of stop-work orders and force majeure events, such as rainstorms and other natural disasters, are also significant causes. Post-design issues often involve illegal building conversions or modifications, ongoing poor maintenance, structural defects, and secondary failures, alongside continuing safety lapses and violations of stop-work orders, all of which contribute to the persistence of building collapses in Lagos.

3.2 Ranking of Identified Causes of Reported Building Collapses in Lagos (2012–2024)

Based on the data presented in Table 1, the ranking of the causes of building collapses in Lagos State was analyzed and is presented in Table 2.

Table 2: Ranking of the Identified Causes of Building Collapse in Lagos: 2012 - 2024

S/No.	Cause	No. of Occurrence	Percentage of occurrence (%)	Position
1	Use of Substandard/poor quality Materials	4	8.33	5th
2	Structural failure including Under-reinforcement/Improper anchorage of reinforcement and structural defects	6	12.5	3rd
3	Lack of or poor Supervision/Poor workmanship	1	2.08	8th
4	Use of quacks/quackery/use of unqualified professionals	1	2.08	8th
5	Violations of Building Regulations/approvals/Distressed Buildings Marked for demolition	14	29.17	1st
6	Illegal conversion of buildings/addition of floors/illegal renovation	6	12.5	3rd
7	Lack of Geotechnical Investigation/Low Soil bearing capacity/Weak and/or Inappropriate foundation	1	2.08	8th
8	Unprofessional Demolition Practices	2	4.17	6th
9	Torrential Rainfall/Rainstorm/Thunder Storm & Secondary failure	11	22.92	2nd
10	Fire/Gas Explosion	2	4.17	6th
	Total	48	100	

The rankings revealed that the leading cause of building collapses in Lagos is violations of building regulations/approvals and distressed buildings marked for demolition. Torrential rainfall, rainstorms, thunder storms, and secondary failure ranked as the second leading cause of building collapse. However, the impact of torrential rainfall, rainstorms, thunder storms, and secondary failure on buildings is dependent on the strength of the structural elements in the building, particularly their resistance to sudden impact. It is therefore reasonable to classify the next two causes, which scored the same points, as the third leading causes of building collapses in Lagos. These include structural

failure, including under-reinforcement and improper anchorage of reinforcement, and structural defects, along with illegal conversions of buildings, addition of floors, or illegal renovations.

This finding partly differs from the research by Omenihu et al. (2016), which identified structural failure as the leading cause of building collapses in Nigeria, followed by the use of sub-standard materials and poor workmanship. This discrepancy highlights the fact that the leading causes of building collapse in Nigeria may vary slightly by location. The following paragraphs discuss the identified causes of building collapses in Lagos for the period under review.

One major cause is the use of substandard or poor-quality materials. The impact of inflation, fluctuating foreign exchange rates, and the rising cost of materials such as cement, steel reinforcements, and concrete products in Nigeria has led to the use of substandard or unsuitable recycled materials, which compromise the safety and stability of buildings. Additionally, contractors' tendencies to cut corners and maximize profits also contribute significantly to this issue.

Structural failure is another key cause. Structural members such as slabs, columns, beams, or cantilevers fail due to the use of substandard materials, improper anchorage of reinforcements, inadequate or inappropriate reinforcement sizes, insufficient supervision of concrete placement, violation of approved designs, and overloading, among other factors.

Lack of supervision and poor workmanship also contribute to the incidence of building collapses. The absence of qualified technical personnel to oversee construction works and the poor workmanship exhibited by laborers are significant factors in building failures.

Poor concreting practices are also critical. The quality of concrete mixes, including the mix ratio and water-cement ratio, directly impacts the strength and stability of a building. If these mixes are not properly monitored for consistency and compliance with standards, the structural integrity of buildings can be compromised over time.

The use of unqualified professionals or quacks is another contributing factor. The demand for cheap labor and rising unemployment rates have led to an increase in the number of unqualified professionals and the proliferation of quacks in the construction industry. If left unaddressed, this problem will continue to negatively affect the safety of buildings in Nigeria.

Violations of building regulations and approvals are another common cause. Building regulations are essential for ensuring the safety, accessibility, and quality of buildings. When these regulations are ignored, it can lead to unsafe conditions, penalties, legal action, and, in the worst cases, loss of life. A common example of violations is the lack of final inspection and occupancy of buildings without a certificate of fitness for habitation.

Illegal conversions of buildings and unauthorized additions of floors are also prevalent. Modifications to approved building plans or the illegal addition of floors are major contributors to building collapses in Lagos.

The lack of geotechnical investigation is another factor. Soil investigation is necessary to determine the suitability of foundations for buildings. Without this investigation, unsuitable foundations may be used, leading to structural instability.

Force majeure events, such as rainstorms and other natural disasters, also play a role in building collapses. These events, which are beyond human control, include windstorms, torrential rain, earthquakes, landslides, and flooding.

Lastly, secondary failure occurs when the collapse of one building leads to damage to neighbouring buildings. The extent of this damage can be minimized through adequate town planning and adherence to design specifications.

3.3 Occurrences of Building Collapse by Year in Lagos, Nigeria

The analysis of the number of incidences per year within the given period in Lagos was also extracted from Table 1.0 and is presented in Table 3.

Table 3: Occurrences of reported Building Collapses by year in Lagos, Nigeria

S/No	Year	No. of Occurrence in Lagos	No. of Occurrence in Nigeria	Percentage Occurrence in Lagos (%)
1	2012	6	18	33.33
2	2013	15	20	75.00
3	2014	7	10	70.00
4	2015	9	10	90.00
5	2016	6	21	28.57
6	2017	7	17	41.18
7	2018	3	8	37.50
8	2019	15	30	50.00
9	2020	7	21	33.33
10	2021	5	6	83.33
11	2022	10	27	37.04
12	2023	8	17	47.06
13	2024	8	36	22.22
	Total	106	241	Average = 49.89%

A total of One Hundred and Six (106) incidences of building collapse were recorded in Lagos from 2012 to July, 2024 leaving more than three hundred and fifty-seven (357) persons dead and several others injured. According to Akuboh (2019), Lagos accounts for the highest occurrence of building collapse incidents in Nigeria from 1974 to 2019 (i.e. 58.06%).The above records shows that Lagos accounted for 47.09% of building collapse incidences from 2012 to 2024 while the other states where incidents were recorded combined to account for 52.91% within same period. The highest frequency of occurrence of building collapse within the period under review was in 2015 with a 90% occurrence in Nigeria while the highest number of occurrences was in 2013 and 2019 each occurring 15 times. Similarly, according to the data of the building collapse prevention guild in Lagos as at August, 2024, 604 Buildings are reported to have collapsed in Nigeria from 1974 with 346 (57.28%) occurrences recorded in Lagos alone.

4. Conclusion

The findings of this study reveals that at least a total of one hundred and six (106) building collapses were identified to have occurred in Lagos from 2012 to 2024 with the leading causes of the occurrence in decreasing order determined as Violation of Building regulations/approvals/distressed buildings marked for demolition, Torrential Rainfall/Rainstorm/Thunder Storm & Secondary failure ranked as the second leading cause of building collapse in Lagos, Structural failure including Under-reinforcement/Improper anchorage of reinforcement and structural defects and Illegal conversion of buildings/addition of suspended floors/illegal renovation. The average frequency of occurrence of building collapse in Lagos from 2012 to 2024 was established as 49.89%. A comparative evaluation of the leading causes of building collapse in Nigeria and Lagos shows that the leading causes of building collapse in Nigeria varies from one location to the other. Nipping the menace of building collapse in Lagos and Nigeria as a whole requires concerted efforts by all professionals of the built environment and the consideration and implementation of the following recommendations:

(i) Strict enforcement to building regulations including conduct of geotechnical investigation will help curb the leading cause of building collapse in Lagos substantially since it is adduced to violations of instructions and statutory provisions/building regulations.

(ii) Improved public awareness and sensitization on the need to engage relevant licensed professionals at all stages of building construction.

(iii) Imposing additional floors beyond original design provision without fulfilment of additional regulatory requirements and safety/stability measures should be avoided.

(iv) Improved capacity development programmes by Professional Regulatory bodies within the built industry.

(v) Building plan approval authorities should also ensure that the purpose of buildings/use are not changed arbitrarily too.

(vi) The Standard Organization of Nigeria (SON) should be vigilant to ensure that building materials imported into the country or produced within the country conform to standard requirements.

(vii) Ensure effective supervision of construction works by competent professionals.

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