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Towards Automation of Building Integrity Tracking: Review of Critical Causes and its Impact on Building Structures in Nigeria

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Abstract

The study examines the causes and its impact of building collapse in two folds: The use of secondary data and also the use of observation based visual inspection survey (inspection based technique) conducted on the affected building structure. The former was done by the collections and analysing the secondary data which included information obtained about causes of collapse from published journal article, academic research reports, newspapers, conference proceedings, were reviewed to generate the required data used for the analysis. While the later was employed, using the digital camera on the different portions of the building, to obtain images of the affected areas. The study attributes the reported building collapse cases to structural defects/ failures, use of substandard building materials, faulty design/ carelessness, heavy down pour, non-compliance with building regulation/ excess loading, foundation problem, unauthorized conversion/ structural masonry, no geotechnical report/ investigation, illegal approval, no proper drainage, large span slab, undersized reinforcement, demolition process and old age illegal. The reveals that out of the one hundred and seventy- two (172) reported cases, that was recorded number of causes, fifty- four are attributed to structural failure/ defects between 1973 and 2022. It also reveals that from the visual inspection survey conducted, shows that the effect of cracks on these building, are the major contribution to the structural defects/ failure that resulted to the collapse of these building structures. The study concludes by suggesting appropriate possible measures to avert the growing increment of building collapse in Nigeria. It also seeks to reduce the impact of building collapse incident through the implementation of the real-time wireless based building integrity monitoring and risk factor indicator system, so as to be able to monitor and analysed the integrity stability of such building structure, before it tends to collapse.

1.0. Introduction

Excess load that is greater than the normal required load carrying capacity can result to the building/ structural failure. This building failure normally occur when there is any loss of bearing capacity of either the building component or the building itself. Structural failure also occurs when a building material used in the construction is stressed beyond its strength limit, (strength of materials). Also, when the rate of overloading of the building structure is more than the actual strength it can contain,

that is exceeding the load bearing ability, then it tends to break which may eventually result to building collapse. When this cause(s) occur they pose negative effect on the structural entity, such entity can be a building component or the structure itself. The basic components that can determine the stability/integrity of a building structure are foundation, floors, walls, beams, columns, roofs; stair etc. [1]. These elements serve the purpose of supporting; enclosing and protecting the building structure. But when there is failure in them as it regards their functionality, they trend to compromise this critical purpose, which they tend to, rendered, and may lead to building failure or collapse as the case may be. [2].

As it regards the foundation of the building structure, the building must have a strong foundation design, because both the underground and bottom floors of the building structure are the most important layers of the structure. In the formation of a multilayer building, first and foremost the location for the structure must be a firm ground. This firm ground will compose of solid rock or compressed soil to ensure that there is no shifting or sinking of the building, the building must rest on concrete slabs that are held up by hundreds of concrete pliers. But if on the other hand, the building is placed on a soil or loose-soil ground, when floods or droughts occur, there will be a problem. This is because if it occurs, it will make the ground either too wet or too dry to support the building.

To prevent this type of problem, the pumping of concrete under the building from sinking that may lead to building collapse as well as raising the building up to where it was first constructed. The foundation is the lowest load-bearing parts of the building. It is usually concrete and it is the first component built. It distributes the weight from the structure on top evenly onto the soil underneath it.

A well-designed foundation can prevent regular construction problem for a building that can develop over time, like the common cracking foundation or uneven load-bearing. To design a good foundation depends on how well it transfers weight to the soil underneath it, so construction teams may study the behaviour of the soil in the construction area to construction the right foundation that can work with the soil and prevent sinking.

Another type of component is the Plinth. The plinth is a building component that is placed directly on the foundation. It is a rectangular wall of stone that goes along the outer dimensions of the building structure. It raises the floor of the building to a few centimetres above the level of the soil outside the building as to prevent ground water entering the building. It also separates the substructure of the foundation from superstructure of the rest of the building.

Considering other building components, we have the Damp proof course (DPC), which is a layer where the water proof material that works to keep out any moisture from entering the building and compromising the building material used.

The floor is also included because it is that flat horizontal surface that supports people and furniture. The process of designing a floor is known as flooring, it runs through the top of the DPC level, and different types of building materials are used for the purpose. The reason for carrying out flooring is to provide a dry and hygienic ground for the building structure. A particular floor to be designed depends on the type of building, it can have multiple floors. When the floors are designed below the soil level outside the building, they are known as the basement floors. The ground floors are designed above the outside soil level. Structures that have multiple floor levels above the ground depend on their relativity to the ground floor. This is followed by the slab. The slab is the vertical base component that can be used as a floor and a ceiling in a building. For example in a one-storey building, it serves as a roof. It will have multiple stories; it serves as a ceiling of one story and floor of the story above it. The function of the slab is to transfer the weight from the story above it vertically to the walls and columns that support the building structure. Another important structural component is the wall. They are vertical building components that support the roof. They are either the exterior or interior wall which their function(s) is to provide security and protection from outside danger that might occur. The exterior walls are the perimeter lines of the structure and its function

is to protect the inside of the building from weather, moisture and provide privacy of the occupants or user. While the interior walls serves to hold the weight of the roof and also be used to segment off space. Another type of wall that can be considered is Shear wall, which is a reinforced vertical component that can withstand distress such as earthquakes or storms. It is designed by adding additional pressure caused by strong winds or shaking from the vertical wall to the horizontal foundation. The column is a vertical loading-bearing component that gives support to the roof by connecting it to the floor. The main function is to support weight within a structure. It can be used in place of a wall to support-weight, provided. It is large enough to withstand the weight of a roof and also any additional weight placed on it. If the column is not carrying weight, it can serve as a visual tea time. The roof is the uppermost structural element of a building structure. It function is to provide covering for the rest of the structure to protect it from weather. We have two-types of roofs such as the flat and the sloped roof. They can be designed from variety of materials, depending on the particular roof that is better for the weather of that region. It is a weight that rests on other load bearing structures. The roof always bears its own weight as a load and other additional pressure from the weather. The staircase is made up of a collection of steps, which allows movement from one floor to another. It carries its own weight and any additional weight as a result from any additional weight as a result from anyone walking on it.

The beams are the horizontal loading bearing component that runs in parallel to support horizontal structure, like decks, floors, or ceiling which is also known as the supporting beams. There are different types of beams which are the plinth beam, tie beam and the truss beams. The plinth beam is a type of beam that runs horizontally along the foundation from one side of the plinth to another, in order to support the weight of a wall that will go on top of it. It can be made of concrete or stone. The tie beam are beams that are designed and placed normally between columns in order to support the weight which the columns carry. The tie beams can be used to also support columns that are holding up tall ceilings. Lastly, the truss beam is a framework that supports something like a roof or a bridge. The Lintel is composed of a slab of concrete or metal that goes above an opening in a wall, such as the window or a doorway. The lintel also provide supports the wall above the opening, distributing the weight to the stronger sides of the wall on either side, and lasting reinforcing the wall where it is weak, that is above such opening. The Sill is that part of a particular wall that are situated under the opening in the building structure. It can be reinforced to support the weight of the window frame. When the above analysed structural building component fails to justify its design purpose(s) it result to building failure. The building failure can occur from different types of problem, it varies from various industries and building type. Some of the causes can be: structure may not be strong and tough enough to support the load, due to its size, shape or choice of material. If the structure or component is not strong enough, catastrophic failure can occur when the structure is stressed beyond its critical stress level. The failure can be resulted from fatigue or corrosion caused by the instability in the structure's geometry, design or material properties. These failures usually begin when cracks form stress points, such as a squared corners or bolt. Holts too close to the material's edge. These cracks grow as the material is repeatedly stressed and loaded (cyclic loading) which eventually reaching a critical length, causing the structure to suddenly fail (collapse) under normal loading conditions. Apart from the various component that were discussed above, failures can be caused by manufacturing errors, including improper selection of materials, incorrect sizing, improper heat-treating, failing to adhere to the design, or shoddy workmanship. This can occur at any time, without prior information to the user and is usually unpredictable. They can also occur through events such as vandalism, sabotage or natural disasters which can be regarded as unexpected problems. It can also occur when the user that maintains the structure is not educated or properly trained and over stressed the structured. It can also be obtained from the used or defective materials. Which are normally unpredictable, since the material may have been improperly manufactured or damaged from prior use: When such failures occur in a building structure, it is too bound to collapse, which normally take place in the internal portion of the building that makes it

difficult to determine or predict if the structure is prone to collapse or not. In order to investigate this trend of causes, a number of Studies have been conducted by some researchers related to this area as it regards to the various causes are highlighted below:

In their work [3], they investigated the effect of building Collapse risks on the stakeholders in the Nigerian built environment. The methodology they implemented was the survey research design (such as the use of distributed questionnaires to target population in some cities (Abuja, Ibadan, Port Harcourt, Owerri and Lagos) in order to obtain their contribution as a stakeholders in the Nigeria built environment on the effect of building collapse risk. At the end of the research, they discovered that the negative effects.

In his paper [4], tithed Analysis of a building collapse, where he investigated and analysed the cause of collapse of a 26 year old office building in 1995, in terms of the discoverability of the condition of a building and the risk inherent in the remedial works. The failure to discover the errors in the original construction resulted in the loss of levels of four people working within the building when it collapsed. Also result investigation into the cause of the collapse revealed the limited valued of original drawings, the problems caused because of collapsed building is not treated as a crime scene.

In their work [5], they were able to identify some relevant causes such as when a building collapse occurs, there is a huge human and economic loss. The problem of ascertaining blames among professional stakeholders in the building industry. This may be as a result of no proper scientific investigation in most developing countries such as Nigeria to ascertain the cause of failure or collapse so as to avoid future occurrence. At the end of their research, they discovered that building materials such as reinforcing steel, cement, sand, granite, sandcrete blocks and concrete play huge important role in either determining the collapse or stability of buildings in Nigeria. Because the important roles which the materials play cannot be compromised and they concluded that 10-25% of building that collapsed in Nigeria are as a result of the use of poor quality building materials. Building is therefore used to provide adequate shelter and form of security/protection to the user without any fear of being collapsed. Eliciting among approach to construction of building, like the use of sandcrete for the construction of beams, shear and load bearing walls, use of sub-standard materials such as reinforcement, cement, and poor concrete also contributed to the collapse of buildings in Nigeria. Other causes can be attributed to either of these main factors such as the natural and manmade factors, examples natural factors are: mud-flow, hurricane and thunder-storm, earthquake erosion and flood, landslide and the man-made factors can be human error, ranging from design, construction method, planning process and building materials. The issue of corruption on the side of the stakeholders, design errors, quacks in the system wrong construction methodology implementation.

In their work [6], they carried out a study that examines causes of building collapse in Nigeria and they also enumerated specific areas the stakeholders in the building industry and the general public are affected. The problem they identified includes; faulty designs, negligence, incompetence, faulty construction, foundation failures, extra ordinary loads, and corruption and forces of nature.

In their study [1], they examined the cost implication and the effects of building structural failures on human lives, material resources and effect on the development of the country, they discovered that the major causes of the structural failures are: non-conformity with quality control standards, over loading of the structure the use of every weak and poor quality construction materials on site, desire for project execution by the client, the use of unqualified professionals, involvement of Non-professionals, insecurity, fraud and corruption etc.

In their study [2]**,** they critically highlight the collapse causes of buildings in Nigeria and provided recommendation to halt the growing collapse issue. Which seeks to shed further light on these causes and the likelihood for the continued collapse of building in Nigeria, if the measures are not urgently and strategically put in place by all concerned stakeholders. They recommended that the need to reduce the impact of man-made phenomena on building through awareness and policy formation by the government.

In their study [7]**,** they investigated the number of collapsed buildings in Nigeria from 2009 to 2019, based on the causes of collapse. They obtained their data from information form published journal articles, conference proceedings, academic reports and newspaper that was reviewed. The result they obtained as it regards causes of building collapse was as a result of structural defects
In their study [8], in their work, they examine the incidences of building collapse in Nigeria. The data for the study was derived from different primary and secondary sources such primary sources include field investigation and site inspection. They employed relevant qualitative and quantitative methods in the analysis of the date obtained. They also attributed the causes of the building collapse to: structural defects, poor supervision/workmanship, use of substandard materials, faulty structural design or absence of structural design, carelessness, rainstorm or heavy downpour, weak and faulty foundation, excessive loading, illegal conversion/non-compliance with approved building plans/disregard for building regulation/plans, hasty construction, faulty construction, ignorant, greedy clients, dilapidation, absence of drainage.

2.0 Materials and Methods

2.1 Materials used/Data Collection

The study examines the causes and its impact of building collapse in two folds: The use of secondary data coupled with observation based visual inspection survey (inspection-based technique) conducted on the affected building structure. The former was based on published journals on reviewed cases of building collapses in Nigeria and information obtained from academic research reports, Newspapers (print and media reports), conference proceedings, which were used for analysis and discussions. While the latter was employed, using the digital camera on the different portions of the building, to obtain images of the affected areas.

2.2 Method of Data Analysis

A 10 years range interval was used to categorize the years of occurrence i.e. events that occurred from 1973–2022 (50years) we were able to get 5 decades. An interval of 10 years was chosen to obtain accurate computation as it regards the base of interest, considering 5 years or 20 years interval will be cumbersome to analyse. In each 10 years interval of occurrence the building collapse were computed. The results from the various intervals was summed up for a particular type(s) of cause for a given year and the total number of occurrence was recorded. The total number of occurrences for a particular decade was added to the other decades to obtain the total number of occurrence for that particular cause of the past 5 decades which gives the exact total number of occurrence of the particular cause for the decades under review. From the reported cases in Table 1 the years under review were divided into 10years interval i.e. 1973 – 1982, 1983 – 1992, 1993 – 2002, 2003 – 2012, 2013 – 2022. All the events of building collapse that occur in a given interval were computed and the number of occurrence for a particular cause was obtained. So in this study, we want to determine the number of causes that occurred most from a group of causes that may result to building collapse. The length of time that will be selected is from 1973–2022, in which 177 reported cases will be reviewed. Then to calculate number of occurrence, we are going to add the number of times the event has occurred for that particular cause for a given interval of occurrence. Using the below assertion;

Total Number of occurrence of a particular cause in 1973 - 2022 (5 decades)	=	No of occurrence of a particular cause in 1973-1982 (1st decade)	+	No of occurrence of a particular cause in 1983-1992 (2nd decade)	+	No of occurrence of a particular cause in 1993-2002 (3rd decade)
	+	No of occurrence of a particular cause in 2003-2012 (4th decade)	+	No of occurrence of a particular cause in 2013-2022 (5th decade)		

And to determine the percentage of number of occurrence was obtained using the below formula;

% Number of occurrence
Of a particular cause in $= \frac{Total\ nos.of\ occurences\ of\ a\ particular\ causes\ in\ 5\ decades}{Total\ nos.\ of\ occurences\ of\ all\ the\ different\ type\ of\ causes\ in\ the\ 5\ decade} \times \frac{100}{1}$

5 decades (1973-2022)

3.0 Results and Discussion

Several reported cases of collapses were evaluated in this work as to verify the trend of collapses and the corresponding deaths. Of the one hundred and seventy- seven (177) cases of building collapses verified between 1973 and 2022 which we considered in this research [9], 956 deaths were verified. In analysing the data obtained, we discovered that for every 10 years interval, occurrences of a building collapse for a particular year that was reviewed, the rate of occurrences of the structural failure/ defects was very high. For reported cases of Building collapse between 1973 and 2022 in Nigeria see Table AI in Appendix A

Table 2: Collapse Records Based on the Cause of Collapse

Courses	**1973 - 1982**	**1983 - 1992**	**1993- 2002**	**2003- 2012**	**2013 - 2022**	**Total**	**% of Occurrence**
Substance building material (SBM)	2	1	-	6	8	17	9.88%
PPCQ	1	-	1	-	-	02	1.16
FP	3	3	1	1	-	08	4.65
HDP	1	1	1	3	4	10	5.81
UK	1	5	4	15	6	41	23.84
SD/F	-	4	16	20	14	54	31.40
FD/C	-	7	2	4	-	13	7.56
UC	-	-	2	-	4	6	3.49
NCBR	1	1	-	6	2	10	5.81
NGR/I	-	-	-	2	1	3	1.74
NPD	-	-	-	1	-	1	0.58
LSS	-	-	-	1	-	1	0.58
USR	-	-	-	1	-	1	0.58
IA	-	-	-	3	-	3	1.74
DP	-	-	-	-	-	1	0.58
OAI	-	-	-	-	-	1	0.58
						172	**100%**

In this work, after the computation of the number of course, it was discovered that there were 172 (one hundred and seventy two) has affected the building structures based on the period under review (1973 – 2022). While the structural failure/defect has the highest of frequency occurrence, with 54 courses (31.40%) and can be found in the Figure 1.

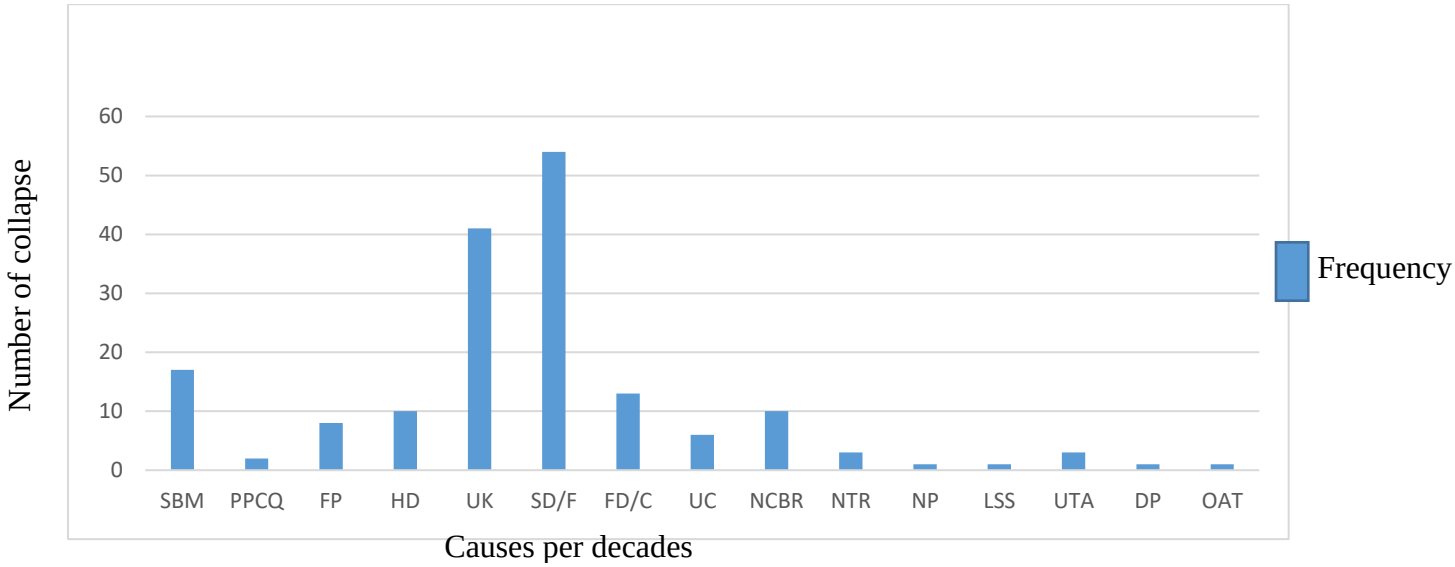

Figure 1- Collapse based on causes of Collapse

Analyzing the above data in Figure 1, we discovered that the case of structural defects/ failure occurred frequently with 54 cases out of the 172 cases that were reviewed. From here it can be seen that among other causes that occurred, the structural defects/failure has the highest rate of occurrences on the issues of building collapses and the deaths.
Source: [8,2,7,10,6,11].

Table 3: Causes of Building Collapse in Nigeria (Disclosed/Known Causes)

S/N	CAUSES OF BUILDING COLLAPSE	FREQUENCY	PERCENTAGE (%)	RANK
1.	Structural defect/failure	54	31.40	1st
2.	Use of Substandard materials	17	9.88	2nd
3.	Faulty design/carelessness	13	7.56	3rd
4.	Heavy downpour	10	5.81	4th
5.	Non-compliance with building regulation/excess loading	10	5.81	4th
6.	Foundation problem	8	4.65	6th
7.	Unauthorized Conversion/Structural masonry	6	3.49	7th
8.	No Geotechnical report investigation	3	1.74	8th
9.	Illegal approval	3	1.74	8th
10.	Poor performance by contractor/quality control	2	1.16	10th
11.	No proper drainage	1	0.58	11th
12.	Large span/slab	1	0.58	11th
13.	Undersized reinforcement	1	0.58	11th

14.	Demolition process	1	0.58	11th
15.	Old age	1	0.58	11th

Undisclosed/unknown causes account for 25.02%
Source: [8, 2, 7, 10, 6, 11]

Table 3 shows the 15 (fifteen) various major causes of building collapse in Nigeria, for the period under reviewed between 1973 to 2022, from the table, we can see that structural failure/ defects accounts for (31.40%) ranked 1st , the use of substandard building material accounts for (9.88 %) ranked 2nd , Faulty Design/ carelessness (7.56%) ranked 3rd , both Heavy Down Pour/ Non Compliance with Building Regulation/ Excess loading, accounts for (5.81%) ranked 4th respectively. Other causes are Foundation Problem (4.65%) ranked 6th, Unauthorized Conversion/ structural masonry (3.49%) ranked 7th, both No Geotechnical Report/ investigation and illegal Approval (1.74 %) ranked 8th, poor performance by contractors/ quality control (1.16 %) ranked 10th, while that of No proper Drainage, Large Span Slab, Undersized Reinforce process and Old Age Illegal accounts for (0.58%) each ranked 11th. Thus, structural failure or structural defects rank first, and in order of presentation above, No proper Drainage/ Large span Slab/ Undersized Reinforcement/ Demolition process/ Old Age illegal ranks the least of the causes of the building collapse in Nigeria.

Fig. 2 Crack at the foundation

Fig.3 Crack around the beam

Fig. 4 Diagonal crack at the column

Fig. 5 Crack along the beam

Fig.6 Crack on the wall

Fig.7 Crack on the decking

3.1 Visual Inspection

For the visual inspection, that was carried out by the authors, using the digital cameras, on the different parts of the building structures, it was discovered that several cracks both longitudinal and transverse were observed especially in the joint between structural components such as the beam and column, beam and roof, beam and foundation and also along the beam, column, wall, and so on. Some of these cracks were found to run from the floors to the roofs. Figure 1 – 8 represents the photographic image of several types of cracks on the different portions of the building structure. From the figures shown, it can be observed the cracks are visible at the plaster of the brick wall or stone wall depending on the type of the building structure, which is an indication of a serious structural issues on the building. Whether the cracks are diagonal, vertical or horizontal, if left unattended to, they could lead to foundation problem in the future, apart from this, and other causes that were also observed were:

(i) Sticking windows and doors: this is when the windows and doors are no longer swings open or close, then it could be a sign that there is a subsidence.
(ii) Bulging or Leaning walls: this is when the straight walls starts to experience a curve inwards, then it is refer to as leaning or bulging walls, these could indicates a structural problem to the wall itself or its foundation.
(iii) Sagging of the roofs and roof leaks: These are issues with its structural caused by the removal of load bearing walls, overloading over time.
(iv) Uneven floors: These was caused by cracked floors joists, dry rot or wet lot.

3.2 Assessment of These Causes from the General Overview

Apart from the author's personal experience and through serious investigations coupled with information update from various media reports, some authenticated identified various critical causes of building failure on the building structures in the country, can be summarized as follows:

(i) Corruption: - This is resulted to the money inducement on the part of the Housing monitoring team, that comprising of the stakeholders that vested with the responsibility to ensure all the rules/ laws in the built industry are adhered to.
(ii) Unqualified professionals: - The use of uneducated and unqualified engineers to supervise a given project, thereby rendering services that are detrimental to the users, which may eventually, resulted to building failure.

(iii)Faulty designs and Constructions: - Faulty designs are always carried out by unqualified architects. This is attributed to the ability of the quake architects to carry out proper feasibility studies, soil and also site investigation which are the important foundation of proper architectural and structural drawings [6]. While that of the wrong construction can be blamed on the unskilled workers (field worker) that are practically involved in the actual build up of the entire structure to its end. These have a great effect on the impact on the building structure stability.

(iv) Overloading: - This is when an additional blocks or reinforce concrete are added to an existing building structure, without fortifying the some important aspect of the building such as the foundation, beams, and columns, when this is not done, the load carrying capacity is increased in such a way the expected elastic limit is exceeded, which will eventually resulted to building failure occurring.

3.3. Validation of the Research work

The research works that was used to validate this research study was that of [7,2], since, in their work, they investigated the various causes under the year under reviewed (2009- 2019), they discovered that the most frequency occurred causes were the building defects/ failure. Also in our research work, it was obtained during the period under review between 1973- 2022, it shows that the building/ structural failure/ defects are the major leading causes of the building structure collapse.

4.0. Conclusion and Recommendation

In terms of the major causes, the structural failure/defects were discovered to be the highest cause of building collapse during the period under review (1973 – 2022). And also effect of cracks on these structures was also proven to have high impact to the contribution of major causes, regards to the deterioration of the structural damage of the various building components of the building structures.

We recommend that monitoring and analysing of these above causes on real time basis in order to mitigate risk impact of corruption (during and after the construction of these building project), to reduce the effect that might arise from the use of substandard materials, the eradication of the danger that might evolved, as a result of the use of unskilled/ quake workers, through serious enactment of policy formation to fortify the already existed laws governing the built industry, the need to always monitor and validate the structural stability before and after use over a given period, which are possible only when the building structure's integrity is constantly been monitored on real- time basis and the risk indicated analysed using the wireless sensor network. Implementing the WSN, the data that will be obtained can be analysed and stored in a database for future reference on the stability of the building structure.

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APPENDIX A

Table AI: Trends of Building collapse cases in Nigeria (1973 and 2022)

S/N	BUILDING LOCATION	DATE OF COLLAPSE	SUSPECTED CAUSES OF BUILDING COLLAPSE	NUMBER OF LIVES LOST
1.	Mokola, Ibadan, Oyo State	October 1974	Excessive Loading	27
2.	Ondo	December 1976	Substandard Building Materials/Structural Defect	8
3.	Oyo	May, 1977	Substandard Building Materials/Structural Defects	10
4.	Borno	Oct. 1977	Poor Performance By Contractor	10
5.	Rivers	March 1978	Lack Of Concrete Services To Hold Foundation	16
6.	Western Avenue, Lagos	December 1978	Undisclosed	Unknown
7.	Lagos	March 1982	Weak Foundation	10
8.	Lagos	June,1982	Weak Foundation	10
9.	Ondo	June 1982	Heavy Downpour/Structural Defect	7
10	Lagos	September 1983	Structural Defect	8
11	Lagos	May, 1985	Faulty Foundation And Bad Workmanship	9
12	Lagos	June, 1985	Weak Foundation	5
13	Bereku Lane, Lagos Island	July 1985	Excessive Loading	9
14	Anambra State Trade Fair Complex	September 1985	Undecided	Unknown
15	Abeokuta Ogun State	October 1985	Faulty Design/Carelessness	10
16	Oshogbo, Osun State	May, 1986	Faulty Design, Carelessness	2
17	Lagos	November 1986	Faulty Foundation	1
18	Agege, Lagos	May 1987	Carelessness	2
19	Ikorodu Road, Lagos	September 1987	Rain Storm Nature	4
20	Idisagbe Lane, Idumota, Lagos	September, 1987	Ignorant Client, No Structural Design	17
22	Akinade Village Ikeja, Lagos	September 1987	Undecided	Unknown
22	Akure Ondo State Nigeria	1988	Structural Failure	Unknown
23	Benin City, Edo State	July1989	None	Undecided
24	Igbobi, Lagos	October 1989	None	Undecided
25	Akinwunmi Street, Mende Village Lagos	October 1989	Faulty Design	Unknown
26	Idumota, Lagos	February 1990	Undecided	None
27	Obasiolu-Diobu, Port Harcourt, River State	June 1990	Ignorant Owner/No Structural Design	Unknown
28	Kano	July, 1991	Substandard Material	3
29	Sokoto	July, 1991	Heavy Downpour/Structural Defect	4
30	Lagos	August 1991	Poor Workmanship/Structural Defect	10
31	Lagos	June, 1992	Defective Structural Design	2 And Several Injured
32	Area 10, Abuja	March 1993	Structural Failure/Poor Workmanship	Unknown
33	Kano	October 1993	Dilapidated Structure	5
34	Lagos	June 1994	Bad Workmanship	1
35	Lagos	June 1994	Structural Defects/Poor Building Materials	10 And 74 Inured

36	Kwara	August 1994	Structural Defect/Poor Workmanship	2 And 6 Injuries
37	Ondo	August 1994	Structural Defect	1 And Several Injuries
38	Oyo	March 1994	Structural Defect	4 And 11 Injured
39	Lagos	June 1994	Bad Workmanship	1
40	Oyo	August 1994	Structural Defect/Substandard Materials	10 And 74 Injured
41	Maryland Ikorodu Road, Lagos	January 1995	Structural Defects, Substandard Materials	1
42	Enugu, Enugu	June 1995	Undisclosed	Unknown
43	Oke-Igbala,MasadoluwaCloase, Obga Lagos	October 1995	Faulty Design/Carelessness	15
44	Oke-Igbala Area, Ibadan, Oyo State	October 1995	Structural Failure	6
45	Central Lagos	October 1995	Faulty Design/Carelessness	10
46	Lagos State	March 1996	Structural Failure	Injuries Only
47	Olowookere Street, Oshodi, Lagos	March 1996	Conversion/Structural Weakness	7
48	Ijagbemi Street, Pedro Lagos	October 1996	Use Of Quacks/Structural Failure	1
49	Illorin, Kwara State	September 1997	Undisclosed	Unknown
50	Mba Street, Ajegunle, Lagos	January 1998	Undisclosed	Unknown
51	Akure, Ondo State	October 1998	Structural Failure/Poor Supervision	8
52	Charity Road, New Oko-Oba, Agege Lagos	June 1999	Structural Failure	None
53	Tokumbo Street, Off Adeniji Adele Road, Lagos	June 1999	Undisclosed	Unknown
54	Four Square Gospel Church, Maitama District, Abuja	October 1999	Structural Failure	Not Available
55	Salisu Street, Ijulshaga Lagos State	October 1999	Rain Storm	20
56	Oke Bola, Ado Ekiti	2000	Poor Quality Control	Nil
57	OdoIkoye, Lagos	2001	Foundation Problem	Nil
58	21,Buhari Street, Mushin Lagos	April 2001	Unauthorized Conversion Of A Bungalow Into A Two Storey Building	7
59	Ojuelegba, Akure, Ondo State	2003	Poor Workmanship And Under Reinforcement	Nil
60	Stadium Road, Akure, Ondo State	2003	No Structural Members	Nil
61	Oyeregbulem, Edo State	2003	Poor Workmanship And Under	Nil
62	Ebuta Meta, Lagos	2003	Structural Defect	8 Injured
63	Port Harcourt Rivers State	2003	Undisclosed	Unknown
64	22, Makinde Street, Ebutemeta, Lagos	2004	Undisclosed	Unknown
65	11, Solola Street, Agege, Lagos	2004	Undisclosed	Unknown
66	Iponri, Lagos	2005	Inappropriate Foundation	Nil
67	OkeSuna, Lagos	2005	Structural Degeneration	1
68	40, Market Street, Shomolu, Lagos	March 2005	Undisclosed	Unknown
69	Ibile Holding, Ikeja, Lagos State	April, 2005	Undisclosed	Unknown
70	Port Harcourt Rivers State	June 2005	Undisclosed	Unknown
71	6, Princess Street, Lagos	July 2005	Undisclosed	1

72	Broad Street, Lagos	2006	Rainstorm	Not Disclosed
73	Commentary Road, Amukoko, Lagos	January, 2006	Ignorance/Greedy Landlord	7
74	Ebuta Meta, Lagos	2006	Structural Defect	37
75	Oworosonki, Benin City, Edo State	2006	Faulty Construction	1
76	Ikpoba-Okha Local Govt, Edo State	April 2006	Undisclosed	2
77	Abuja	June, 2006	Undisclosed	None
78	Apongbon, Lagos	2007	Structural Defect	3 Injured
79	Ikeja Lagos	2008	Faulty Construction	Several Injured
80	Alade Street, Lagos	2008	Structural Defect	3 And 5 Injured
81	Ogudu, Ojota Lagos	April, 2008	Undisclosed	Unknown
82	Wuse, Area Abuja	August 2008	Structural Failure/Incompetency/Bad Workmanship	2 People Injured And 100 People Trapped
83	Ojerinde Street, Idi-Araba Lagos	2009	Excessive Loading/ Faulty Construction	9 Died, 3 Missing And 31 Injured
84	AjegunleApapa. Lagos	2009	Structural Degeneration	Not Disclosed
85	Ogbomosho, Oyo State	February 2009	Use Of Substandard Material, Poor Workmanship/Supervision	5
86	Ogbomoso Oyo State	March 2009	Undisclosed	5
87	Lagos	June 2009	Undsiclosed	7
88	Oke Padre StreetmIta-Morin, Abeokuta, Ogun State	October 2009	Use Of Substandard Materials/Hasty Construction	3 Died And 11 Injured
89	Garki, Abuja	November 2009	Structural Failure Substandard Material	Unknown
90	Abuja	2010	Faulty Construction	Not Disclosed
91	Isopakodowo Street, Cairo Oshodi Lagos	April 2010	Use Of Substandard Material	4 Persons 12 Injured
92	Adenike Street, Off New Market Oniru Estate Lagos	June 2010	Use Of Substandard Materials, None Compliance With Approved Building Plans And Weak Structure	1 Person And 2 Injured
93	Nkwerre Street, Garki, Abuja	June 2010	Non Compliance With Building Regulations	1
94	Plot 702 Port Harcourt Crescent Garki Abuja	July, 2010	Substandard Materials And Qualified And Unqualified Professionals	11
95	Aghaji Crescent GRA, Enugu	August 2010	No Proper Drainage	1
96	Ikole Street, Area 11, Abuja	August 2010	Undisclosed	5 People And 40 Squatters Where Trapped
97	2 Okolie Street, Off Abuja	August 2010	Substandard Materials	23 Died 11 Injured
98	24, Alli Street Victoria Island, Lagos	September 2010	Structural Defect/Overloading	3
99	Oba Ife Housing Estate Akure	2011	Structural Failure	None
100	Kano	2011	Rainstorm	6
101	Abuja	2011	Overloading	100

102	9b, Ademibi Close, Ikeja, Lagos State	March 2011	Structural Defect	2
103	Nyanya, Abuja	June 2011	Large Span Slab	4
104	11, Aderibigbe Street, Maryland, Lagos	June 2011	No Geotechnical Investigation	None
105	NdiaguAmechi Road, Amechi, Enugu	June 2011	Undersized Reinforcement	3
106	Maraba (Near Abuja)	June 2011	No Geotechnical Investigation Undersized Reinforcement, Large Span Slab, No Specific Floor Thickness On Drawing	2 Died, 11 Injured
107	20, DoyinOmoluyi Street, Alapere, In Agboyi Ketu Local Council Development Area In Lagos State	July 16, 2011	Undisclosed	2 Dead
108	Oloro Street Off Cemetery, Lagos	July 2011	Non Adherence To Building Standards & Regulations	10
109	6, Magaji Close Idumota Lagos	July, 2011	Undisclosed	18
110	Orosanye Street, Lagos	August 2011	Wrong Supervision	None
111	Aderibigbe Street, Maryland Lagos	October 2011	Structural Failure	2
112	16, Nnobi Street, Enugu, Enugu State, Nigeria	2012	Structural Failure	Not Reported
113	Owerri, Imo State	2012	Flooding	Not Reported
114	Awka, Anambra State	2012	Defective Building	Unknown
115	Abuja	2012	Unsupervised Demolition	2
116	Gwarinpa Estate Abuja	January 2012	Structural Defect And Demolition Operation	3
117	Apo Mechanic Village, Abuja	June 2012	No Building Approval No Qualified Professional On Site, Poor Supervision Use Of Poor Quality Materials	Unknown
118	Hadeja Road, By Ibrahim Taiwo Road, Gombe	July 2012	Building Has Passed Its Limit State	1
119	3, AdemolaAwosike Road, Kubwa Extension 111, Abuja	August 2012	Poor Quality Material, Poor Workmanship	3 Died, 9 Injured
120	Jakande Estate Oke-Ake Aa, Isolo Lagos	November 2012	Structural Failure And Occupants Ignored The Government's Safety	3
121	MuriOkunolaStreeet, Eti-Osa LGA of Victoria Island Lagos	November 2012	Structural Failure	3 Dead 50 Trapped
122	174 Corporation Drive Dolphin Estate, Ikoyi Lagos	November 2012	Structural Failure	None
123	Ojodu, Lagos	May 2013	Illegal Approval	1
124	Abgama Area, Umuahia, Abia State	May 2013	Undisclosed	7
125	Ojodu, Lagos	May 2013	Undisclosed	2
126	Agege Motor Road, Mushin Lagos	June 2013	Unauthorized Conversion	1
127	Ishago Road, Surulere Lagos	July 2013	Non Compliance To Regulatory Authority Warnings Inferior Building Materials	4
128	Lagos Island	September 2013	Undisclosed	2
129	Maitama, Abuja	September 2013	Undisclosed	3
130	Nyanya Abuja	September 2013	Undisclosed	8 Injured
131	Amassoma In Southern Ijaw LGA Of Bayelsa State	October 2013	Use Of Substandard Materials	None

132	Akure Ondo State	May 2014	No Geotechnical Report	2
133	Agudama-Epie, Near Yenagoa, Bayelsa	May 2014	Use Of Quacks Heavy Downpour	20 Injured
134	Ologuneru In Ido LGA, Ibadan City, Oyo	May 2014	Undisclosed	1
135	Pedro Police Station, Somolu Lagos	June 2014	Undisclosed	Unknown
136	Onitsha, Anambra State	June, 2014	Structural Failure	4
137	Bucknor Estate, Jakande-Isherioshun Road Ejigbo/Isolo Lagos State	July 2014	Structural Failure	None
138	Osogbo, Osun State	August 2014	Heavy Downpour	One Injured
139	Ikotun-Egbe Area Of Lagos State, Nigeria	September 2014	Demolition Process	4
140	Liberty Power Bible Church, Benin, Edo State	September 2014	Structural Defect And Use Of Substandard Material	
141	6, Mogaji Street, Idumota Lagos Island	March 2015	Undisclosed	1
142	Ebuta Meta Lagos	July 2015	Structural Defect	4
143	Swamp Street, Odunfa Lagos Island	October 2015	Structural Defects	4
144	Lekki Lagos	2016		
145	Lekki, Lagos	March 2016	Addition To The Approved Number Of Floors	34
146	Mile 12, Lagos	March 2016	Structural Defects	1 Dead 1 Injured
147	LafenwaSapon Road, Itoku Abeokuta, Ogun	May 2016	Structural Defects	2
148	Ojodu Lagos	May 2016	Undisclosed	2
149	AkwaIbom State, Nigeria	December 2016	Structural Failure	100
150	Ulakwo Junction, Owerri North LGA, Imo State	July 2017	Undisclosed	3
151	Zulu Gambari Road, Illorin, Kwara State	August 2017	Undisclosed	Unknown
152	Abuja	August 2018	Old Age Illegal	2 Dead 3 Injured
153	Jabi, Abuja	August 2018	Substandard Materials	2
154	Okpuno, Otolo In Nnewi, Anambra	October 2018	Substandard Materials	None
155	IfiteAwka, Anambra State	November 2018	Substandard Materials	None
156	Woji Road, GRA Phase 2, Port Harcourt, Rivers State	November 2018	Undisclosed	15 Died And 31 Rescued
157	Lagos Island	February 2019	Undisclosed	2
158	ItaFaaji Area Of Lagos State, Nigeria	March 13 2019	The Change Of Use Of The Building From The Intended Purpose	20
159	Sogoye, Bode Area Of Ibadan, Oyo State	March 2019	Concrete Was Not Adequately Cured During Construction	None
160	No 12, Alasepe Street, Off Community Road, Ayo Palace Way, Okota, Lagos, Nigeria	17th January 2020	As A Result Of Substandard Rehabilitation Materials Used For Reconstruction And Ageing Of The Building Which Made The Entire Building Cared In Under Duress	One Escapes Death
161	Freeman Street, Lagos Island, Lagos State	July 11, 2020	Building Was Said To Have Suffered Total Collapse	1 Dead, Six Others Were Rescued

162	No 46, Gafari Balogun Street, Ogudu Area Of Lagos State	22nd July 2020	Heavy Rainfall	
163	No 95, Abeokuta Street Cemetery, EbuteMeta Area Of Lagos State Nigeria	24th July 2020	Self Collapse	Nil
164	Abuja, Nigeria	25th July 2020	The Building Was A Bungalow But The Developer Was Trying To Upgrade It To A Two Storey Building And It Suffered A Total Collapse	10 People Injured
165	Dangawon Jingau Street, in Kuma Asabe Kano State	29th July 2020	Undisclosed	
166	62, Do Street, Obalense, Lagos Island	Oct 12, 2020	Partially Collapsed	6 Persons Dead
167	At Commercial Hub, Along Azikiwe Road, Aba, Abia State	September 16, 2020	Torrential Rain	5 Persons Dead
168	15, Ansarudeen Street, Ile-Epo Bus Stop, Lagos State	Saturday, September 19, 2020	The Excel College Had Shown Signs Of Distress Before Its Collapse And That The School Was Planning To Renovate The Structure Before The Incident Happened	
169	Along Gerrard Road, Ikoyi, Lagos	November 1st 2021	Structural Defect Caused By Overloading, As A Result Of The Erosion Of Professional Ethics And Due Diligence	46 Persons Dead
170	Lagos, Nigeria	November 17th 2021	Owner Converted Old Bungalow To A Storey Building	4 People
171	Okpanam Community, Oshimili North Local Government Area CLGA, Delta State	January 11, 2022 - Tuesday	Undisclosed	3 Persons Dead
172	Akunde Crescent OnikeLaba Area Of Lagos, Lagos State	February 12, 2022 – Saturday	Compromise In The Quality Of The Materials Used. The Developer Break The Government Seal On The Property And Also Violated The Stop Hole Order Placed In The Building	3 Persons Dead
173	Ahmadu Bello Way, Opposite State Library, Kano, Nigeria	March 17th 2022	Damage (Structural), Structural Failures, And Storey Building Under Construction.	One Dead, Several Injured
174	Iperu in the Iheme Local Government Area, Ogun State	March 23rd 2022	Poor enforcement of regulations guiding the construction industry by the government to the incessant building collapse Undergoing illegal constructs by the owner	2 people dead
175	No 32, Ibadan Street, Off Herbal Macaulay Way, Ebute-Meta	April, 1st 2022	Failed integrity test mark for demolition, some occupants left but the rest material testing	10 death
176	Chris Igade Street, Off Ago Palace Wary, Opposite Kilamajaro/AP , Lagos State	May 7th 2022	Structural defects	No casualty was recorded during the incident
177	Freeman Street, Lagos Island, Lagos	May 21st 2022	Heavy downpour (rainfall)/structural failure	1 dead

Source: [8,2,7,10,6,11]