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The trend of collapse of buildings in concrete materials in Lagos State, Nigeria (2013-2019)

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Abstract. Buildings are essential structures that provide mankind with accommodation in the form of offices, factories, residences, etc. Building Infrastructure aid to increase the Gross domestic product of nations by meeting the present needs as well as helping in the reduction of future deficiencies. Unfortunately, in developing countries like Nigeria, regular occurrence of collapse of buildings in concrete materials have dealt a terrible blow to the nation, leading to losses in the form of death and damage to properties. This study aims to show the trend within the period of 2013 to 2019. This study used statistical methods to assess the fatality rate, types of buildings affected, frequency of occurrences and the causative factors. The result indicates that the year2017 witnessed 14 collapse incidences making it the highest within the study period in Lagos state. Furthermore, 204 persons lost their lives in 2014, making it the highest within the period. The results obtained showed that the risk of collapse and fatality rises as the building height goes up and when unauthorized floors are added to an existing building.

Keywords: Building collapse, Concrete materials, Lagos State, Poor construction quality, Substandard materials

1. Introduction

Globally, crises such as insecurity, disasters, ill-health and environmental degradation have continued to pose a significant challenge to the human race. Disasters, both man-made and natural, have hindered the attainment of Sustainable Development Goals (SDGs) in most countries. The impact is mostly felt in under-developed and developing nations where capacities to manage such is lacking [1]. One of such frequently occurring disaster in Nigeria is building collapse [2, 3].Reseachers in[1] stated that building collapse is a significant threat to the development goals of Nigeria. Buildings are essential amenities because they provide man with accommodation in the forms of offices, factories, residences, etc. They play a fundamental role in the economy of nations by offering jobs for different professions, class and cadres of people [4]. Building infrastructure ought to increase the National Gross Domestic Product (GDP) by meeting present needs as well as help in the reduction of future

deficiencies [5]. Falobi[6]defined building collapse as the loss in bearing capacity leading to the sudden falling apart of the structure. Buildings are designed to be safe and avoid failure, which could lead to death and damages to property [7]. The effect of building failures has the potential of inhibiting the development of any society [8].Due to the importance of buildings to the society and the need to contribute towards achieving the SDGs, this research evaluates the trend of building collapse within the period of 2013 to 2019 in Lagos State, the epicentre of building collapse in Nigeria. Statistical approach was used to evaluated the fatality rate, types of housesinvolved, rate of incidences and the relevant causes.

2. Literature Review

The government of Nigeria has over the years made concerted efforts in increasing the quantitative but not qualitative provision of houses for its citizens and residents [9]. They have done this through budgetary and policy requirements. However, the building collapse phenomenon has continued unabated ever since the first recorded case at Ibadan in 1974 [10]. Available reports show that in Nigeria not fewer than 379 deaths, several undiscovered deaths, injuries and properties worth billions of naira have been lost due to collapse between 1980 and 2005 [11]. In recent years, the situation has become more worrisome due to the incapacity to manage the disaster, frequency of occurrence and increase in the number of casualties. In recent times, two terrible collapse cases have involved church buildings. The first occurred in Lagos on September 2014 with total fatalities of 116 people while the second happened in Uyo on December 2016 with a record of 160 people dead [2]. Causes of building collapse include sub-standard materials, insufficient supervision, greed, corruption, non-adherence to building code, etc. [12]. The consequences of building failure are usually very fatal. They include economic losses, loss of lives, disability, damage to properties, increase in the number of homeless people, loss of time and valuable resources [13, 14]. Due to the frequent collapse of buildings, conserving the existing and future building stock is a significant challenge in Nigeria [14].The work in[15] reported that 20.3% of collapse cases recorded zero death, 44.4% of collapse cases was responsible for 1-5 deaths, 26% of collapse cases induced 5-20 deaths and more than 21 people in 9.3% of the collapse cases in Nigeria. The number of fatalities further buttresses the severity of the problem and in situations where no life was lost, physical injuries are equally as severe. Apart from the deaths, any incident of building collapse leads to loss of properties and productive time which could hurt the socio-economy of any society [10].

The building collapse prevention guild (BCPG), which is a body composed of professionals in the construction industry in Nigeria has reported that 80% of construction projects in Lagos State are carried out by charlatans with no involvement of professionals [16]. It has urged the Lagos State government to give attention to buildings in the State, and provide particular attention to buildings at Mushin, Ebute-Metta, Lagos Island, Bariga and Ajegunle. Reports from BCPG also indicates that in 2019 Lagos state had 17 collapse incidences making it the highest and accounting for about 39% of total failure in the country [17]. According to the report, 59% of the collapsed buildings in Lagos state were existing structures while 41% were under construction. 10 were partial collapse while seven were total collapse cases.

It is very disheartening to notice that almost all the building collapse that occur in Nigeria affect structures built with concrete materials, in the form of reinforced concrete or sand-crete blocks of cement materials. This is coming at a time in which sustainability is the watch word across all the nations of the earth. Achieving Sustainable Development Goals (SDGs) is vigorously being pursued all over the world, while buildings and infrastructures needed to improve the quality of human lives are overly collapsing in Nigeria. In other to improve the efficiency and sustainability of built structures, researchers are coming up with innovative materials obtained from intelligent material combinations [18 – 20] or from the transformation of waste materials to useful resources [21- 23].

Another approach to improve the stock of build structures is through sustainable structural health monitoring and continuous structural damage assessment and maintenance [24-26].

Lagos State is located in the south-western area of Nigeria. It holds the status of being the smallest yet possessing the most populous conurbations in the world. It is Nigeria's largest urban area, with 20 local government areas (LGA) and 57 local council development area (LCDA). Researchers in[27]while assessing the building collapse cases in Nigeria between 2009-2019 noted that the Southwest had 34 cases of building collapses making it the highest number of failures (60% of total failures within the period) with 132 deaths (64% of entire death within the study period). The debris of a collapsed plaza is shown in Figure 1, while Figure 2 shows a typical rescue operation taking place at a collapsed site at Lagos Island.

This study, therefore, seeks to analyse the trend of building collapse in Lagos State, Nigeria, between 2013-2019. It is believed that the results of this research will help the stakeholders to be more informed of the impact of building collapse in the society. The impact of these collapses is enormous. Hence, adequate measures need to be taken by all involved stakeholders in the construction industry to stop this trend.

Figure 1: A collapsed plaza in Lagos state. Source: [16]. The Punch, https://punchng.com/nigeria-recorded-43-building-collapse-cases-in-2019-report/

Figure 2: Rescue workers at scene of collapsed building at Lagos Island. [19], The Punch newspaper, https://punchng.com/36-000-potential-collapses-waiting-to-happen-says-building-collapse-prevention-guild/

3. Methodology
The data used for this study was the recorded structural collapse between 2013-2019, obtained from journals, conference proceedings, reports and newspapers, Lagos State Physical Planning and Development Authority and the Lagos State Material Testing Laboratory. They were reviewed to obtain relevant data such as fatality rate, frequency of occurrence, number of buildings affected, locations, major causes, etc. The data obtained were analysed using descriptive as well as mathematical statistical stools. The study area chosen is Lagos State and is shown in Figure 3.

Figure 3: Lagos State map (Link, 2017).

From the secondary sources, data pertaining to causes of collapse in Lagos State over the past years weregathered.Inadditiontothis,thedatesaswellastypeofbuilding,numberofliveslost,numberofthose injuredandtheirdatesofoccurrence were assembled.Thesedatawere organizedintables andcharts. The statisticalanalysiscarried featured charts showing the effect of building collapse, types of buildings and their frequency, locations and causes ofcollapse.

4. Results
Table 1 below shows the year and the number of persons affected, including death, injured and rescued. The types of buildings and their frequency of occurrence within the study period is shown in Table 2. Information of the number of building collapse each year is shown in Table 3. Specific locations and their frequency of occurrence can be seen in Table 4. Table 5 presents the most frequently adduced causes of building collapse for the study period.

5. Discussion
From table 1, it can be seen that 2014 had the highest fatality rate of 232 persons while only four persons were confirmed dead in 2019. Table 2 showed that three-story buildings were the most frequently collapsed type of building with a value of 11 and was closely followed by four-story buildings with nine collapses. From here, it can be seen that that the risk of collapse and fatalities increases as the building heights rises. Table 3 showed that within the study period, 2017 was the year with the highest number of building collapse with a value of 14 which is half the total number of

failures within the study area and period. From table 4, it appears obvious that Lagos Island is the area with the highest incidence of collapse. This may not be unconnected with the fact that they host a higher number of high-rise structures and that many of the buildings in the area are aged and unmaintained buildings. Based on table 5, it can be seen that between 2013 and 2019, the primary cause of building collapse in Lagos State was the addition of extra floors to pre-existing structure not designed for such. Efforts must also be made at curtailing the incessant availability of substandard building materials in the Nigerian market.

Table 1: Number of persons affected by structural collapse between 2013-2019 in Lagos state

YEAR	NUMBER OF DEATHS OR FATALITES	NUMBER OF INJURED PERSONS	NUMBEROF RESCUED PERSONS
2013	16	35	0
2014	232	0	0
2015	120	131	11
2016	36	0	0
2017	31	64	52
2018	4	0	36
2019	34	72	7
TOTAL	439	302	106

Table 2: Types of building collapse with their frequency of collapse.

TYPE OF BUILDING	FREQUENCY	PERCENTAGE
Others	4	9.76
Unidentified	5	12.20
Three storey building	11	26.83
Four-storey building	9	21.95
Five-story building	4	9.76
Six-storey guest house	2	4.88
Bungalow	4	9.76
Church	2	4.88
Total	41	100.0

Table 3: Number of building collapse per year in Lagos state between 2013-2019

YEARS	NUMBER OF BUILDING COLLAPSE	PERCENTAGE
YEAR 2013	5	12.20
YEAR 2014	2	4.87
YEAR 2015	3	7.31
YEAR 2016	2	4.87
YEAR 2017	14	34.15
YEAR 2018	2	4.87
YEAR 2019	13	31.70
Total	41	100

Table 4: Specific location of collapse and their frequency

LOCATION	FREQUENCY	PERCENTAGE
Lagos, Alagbado	1	2.43
Lagos Island	13	31.7
Lagos, Alaba Market	1	2.43
Lagos, Lekki	6	14.63
Lagos, Illasa	1	2.43
Lagos, Ebute Meta	3	7.31
Lagos, Surulere	2	4.87
Lagos, Ikeja	1	2.43
Lagos, Agege	2	4.87
Lagos, magodo	2	4.87
Lagos	8	19.51

Lagos, Ikotun	1	2.43
Total	41	100.0

Table 5: showing the reasons of building collapse and their frequency

CAUSES	FREQUENCY	PERCENTAGE
Substandard building materials	7	17.07
Defective and illegal construction	5	12.20
Additional storey	8	19.51
Distressed building	5	12.20
False Prototype and fake COREN stamps	1	2.43
Natural disaster Rain	1	2.43
Noncompliance to building regulation	2	4.87
Unidentified	1	2.43
Under construction	3	7.32
Faulty foundation	1	2.43
Collapsed building fell on it	1	2.43
Staircase collapse	1	2.43
Defiance	1	2.43
Mudslide	1	2.43
Others	3	7.32
Total	41	100.0

6. Conclusion

The rate of building collapse especially in Lagos State has become a concern to all. The impact of such collapse is tremendous leading to loss of lives and properties. It was observed that most collapses occurred within the Lagos Island metropolis possibly due to high rise buildings in the area. The year 2017 within the study period, witnessed the highest number of collapses in Lagos state. However, 204 persons lost their lives in 2014, making it the highest within the study period. It is recommended that regulatory bodies like town planning authority assess buildings from time to time to prevent this reoccurring disaster and take stiff measures to punish defaulters in order to serve as a deterrent to others. Standard materials should be used and professionals should be involved in construction projects. Further studies can be carried out to assess the trend of collapse in recent time.

From this research, it can be seen that the risk of collapse and fatality becomes high as the height of buildings rise. It is also very evident to notice that the adding of unauthorized floors to an existing building can be very catastrophic. For these reasons, it is very important that only qualified professionals handle building projects, more especially for high-rise buildings. It is also vital that government agencies saddled with the oversight of building construction projects live up to the expectations of their mandate. These measures will help to reduce the risks of building collapse and fatalities.

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