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Building Collapse in Nigeria during recent years – Causes, effects and way forward

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Abstract. Building collapse in Nigeria in the last few decades is a growing concern for investors and the government alike. Many of the documented cases of building collapse in Nigeria are due to the use of defective or substandard building materials, no requisite technical knowledge, non-adherence to building codes and standards, the use of non-professionals and the high level of corruption which has ravaged every sphere of the construction industry including government and private parastatals. In addition to the established causes of the collapse of structures, empirical data from developed countries of the world has shown that many of the recorded cases in this climes are due to the fact that the current codes of practice do not make provisions for unexpected loads and an unexpected failure of a single member may lead to an all-round collapse of the entire structure. This study critically highlights the collapse cases of buildings in Nigeria and provides recommendations to halt this growing concern. It seeks to shed further light on these causes and the likelihood for the continued collapse of buildings in Nigeria if measures are not urgently and strategically put in place by all concerned stakeholders. It also seeks to reduce the impact of man-made phenomena on buildings through awareness and policy formulation by the government.

1. Introduction

Buildings are civil engineering structures, constructed in various forms, with different materials, and for specific uses, e.g. to provide shelter for lives and properties. A building is built with considerations for safety, serviceability and economy. This study provides critical reasoning and contributions regarding structural failures observed in Nigeria.

Building collapse is a failure in a structure due to its inability to serve the purpose for which it was built [1]. In 2013, collapse of Rana Plaza, an eighty storey commercial building in Savar, Dhaka, Bangladesh, resulted in over 1200 deaths and injury to an estimated 2500 other [2]. The 2014 Synagogue Church building collapse in Lagos, Nigeria with at least 116 deaths, the 2015 Mecca crane collapse in Mecca, Saudi Arabia claiming 184 lives and the Uyo Church collapse in Uyo, Nigeria causing 60 deaths and injuries to a lot more [3]. The 2019 Lagos School collapse in Lagos, Nigeria causing 20 deaths and over 60 injured. The 2015 collapse of the 19th century Tower, Dharahara building in Kathmandu, Nepal on May 25 caused by an earthquake resulted in 200 fatalities. These are just a few of the collapse cases around the world. These cases are more in developing cities as a result of urbanization and the need to provide shelter for the influx of people trooping into the cities every day. This has, in fact, led to an increase in 'building contractors' of zero training and doubtful competences. [4] researched the fatality rate in the forty-seven cases of building collapse from 2000 to 2010. He reported not less than 300 deaths and casualties in Nigeria's major cities alone with an enormous loss of investment. The increasing number of cases mandates the need for a wakeup call to all stakeholders in the industry.

Failure of a structure is not just a result of ultimate collapse but when any part of the structure or the whole structure becomes unfit for use for the intended loadings for which it was designed to carry. Failure of a structure then could be any of the three scenarios:

i. Serviceability limit state failure occurs when it becomes unserviceable by undergoing excessive deflection and cracking;
ii. Ultimate limit state failure happens when it fails by overturning, ultimate collapse, or wobbling of the columns. The structure is said to have failed in Ultimate limit state.
iii. Durability failure has to do with the weakening of the components beyond reparable limits.

The traditional materials used in previous centuries made buckling not a major structural problem and multi-storey structures were uncommon during these ages. There is a tendency to make sure important structures do not fail by using materials generously making many of the roman structures survived till date [5].

The standard of living has increased over the centuries bringing with it huge strides in technological advancements. Today, there are better procedures, more durable materials, better construction machinery and more advanced knowledge on construction. However, with all the advances in technology, there are still cases of collapse in countries of the world, though more prevalent in developing countries like Nigeria. Collapse in the developed countries is majorly due to natural causes or man-made causes like bombings like the world trade centre. However, collapse in developing countries are usually due to poor quality or substandard materials, poor supervision, non-adherence to standards and regulations, unqualified professional, overloading, no geotechnical/sub-soil investigation, poor construction procedure, illegal approval, wrong demolition process, lack of maintenance and numerous others [1, 8-12].

Table 1: Summary of collapsed buildings and fatalities between 2010 and 2019 in the 21st century in Nigeria.

References	Structure	Date	Location	Cause of Collapse	Fatality
[6]	Residential under construction	April 26, 2010	Isopakodowo street Cairo, Lagos.	Use of substandard building materials.	4
[7]	Residential under construction	June 2010	Oniru Estate, Victoria Island.	Substandard materials, haphazard works.	1
[7]	2-storey building under construction	June 2010	Nkwerre Street Garki, Abuja.	Non-compliance with building regulations	1
[8]	6 suspended floors for commercial purpose.	July 2010	Plot 702 Port-Harcourt crescent Garki Abuja	Substandard materials and unqualified professionals	11
[6]	A wall fence.	August 10, 2010	Aghaji crescent GRA. Enugu.	No proper drainage	1
[9]	Uncompleted 4-storey building	August 11, 2010	Ikole street, Abuja	Substandard materials & disregard for building regulations	23
[10]	4-storey building	September, 2010	28 Tinubu street VI Lagos.	Structural defect/overloading	3
[11]	Five-storey	June 2011	11 Aderibigbe Street, Maryland, Lagos.	No geotechnical investigation,	None
[7]	4-storey building	June 2011	Ndiagu Amechi Road Enugu	undersized reinforcement,	3

[7]	2-storey building	June 2011	Nyanya, Abuja	large span slab	4
[8]	2-storey building	June 29, 2011	Maraba (near Abuja)	No specific floor thickness on structural drawing	2
[7]	3-storey building	July 2011	Oloto Street, off Cemetery Road, Ebute Metta, Lagos	Non-adherence to building standards & regulations	10
[7]	3-storey building	August 2011	Orosanye Street Lagos.	Wrong Supervision	-
[8]	Two storey building.	January 28, 2012	Gwarinpa Estate Abuja	Structural defect and demolition operation	3
[7]	2-floor Commercial building.	Wednesday, June 13, 2012.	Apo Mechanic Village.	There was no building approval and no qualified on site.	14
[8]	101-year-old 3-storey commercial building.	July 2012	Hadeja Road by Ibrahim Taiwo Road Gombe	Building has passed its limit state.	1
[8]	2-storey building under construction	August 8, 2012	3, Ademola Awosike Road Kubwa Extension III, Abuja	Poor quality materials, poor workmanship, inadequate/weak foundation.	3
[8]	Building in use	November 20, 2012	Jakande estate Oke-Ake Afa, Isolo Lagos	Structural failure and occupants ignored the government's safety warning.	3
[12]	A twin four-storey duplex	November 3, 2013	Victoria Island, Lagos	Unknown	4
[8]	Abu Naimi school building.	September 2014	Bukuru Jos.	Structural defect and illegal conversion	10
[3]	Synagogue Church of All Nations (SCOAN)	September 12, 2014	Ikotun-Egbe area of Lagos state, Nigeria.	Structural failure	116
[8]	Synagogue Warehouse Church, Lagos.	September 12, 2014	Ikotun-Egbe area of Lagos state, Nigeria.	Demolition process	4
[8]	Liberty power bible church, Benin	September 30, 2014	Liberty power bible church, Benin	Structural defect and use of substandard material	-
[12]	4-storey building	March 13, 2015	6 Mogaji Street Idumota Lagos island	Unknown	1
[8]	3-storey building	July 15, 2015	Ebuta meta Lagos	Structural defects	-
[8]	3-storey building	October 21, 2015	Swamp street Odunfa Lagos island.	Structural defects	-

[13]	A five-story building under construction	March 9, 2016	Lekki, Lagos.	Addition to the approved number of floors.	34
[8]	Two storey building	March 19, 2016	Mile 12, Lagos	Structural defects	1
[8]	Residential building	April 2016.	Horizon 1, Lekki Garden, Ikate.	Structural defects	18
[8]	Commercial complex	May 13, 2016	Lafenwa Sapon Road, Itoku, Abeokuta.	Structural defects	2
[3]	The Reigners Bible Church.	December 10, 2016	Akwa Ibom State, Nigeria	Structural failure	100
[14]	4-storey building	July 25, 2017	3 Massey St, Lagos Island	Undisclosed	6
[14]	A storey building	July 8, 2017	Ulakwo junction, Owerri North LGA, Imo State	Undisclosed	3
[8]	Four storey building	August 18, 2017	Zulu Gambari Road, Ilorin	Undisclosed	-
[14]	4-storey building	July 17, 2018	Owelle Aja Layout, Obosi, Anambra.	Substandard materials with addition of two un-designed floors.	-
[14]	4-storey building	August 16, 2018	Jabi, FCT Abuja.	Substandard materials	2
[14]	3-storey building	October 18, 2018	Okpuno, otolo in Nnewi, Anambra.	Substandard materials.	-
[14]	3-storey building	October 2018	Ifite Awka, Anambra State	Substandard material	-
[8]	7-storey building	November 23, 2018	Woji road, GRA phase 2, Port Harcourt	Undisclosed	5
[8]	3-storey building	February 3, 2019	Lagos Island	Not reported	2
[8]	A three-storey building	March 13, 2019	Ita Faaji area of Lagos state, Nigeria	The change of use of the building from the intended purpose.	20
[8]	3-storey building under construction	March 15, 2019	Sogoye, Bode area of Ibadan	Concrete was not adequately cured during construction.	-

2. Research Methodology

To actualize the aim of this research data was collected using primary source of well-structured questionnaires distributed among the various professionals in the built industry as well as secondary sources from journal publications and conference proceedings, Nigerian dailies and technical reports from credible sources on the internet.

The questionnaire was designed using google form with the sole aim of reaching in time a wider range of the targeted professionals through the electronic mail. It captured the causes of collapse, roles of individuals, Natural and man-made conditions.

3. Results and Findings

From Figure 1, Man-made conditions are regarded as the major cause of building collapse over the decade. Whereas natural conditions contributes less to the cause of structural failure in most countries this present decade.

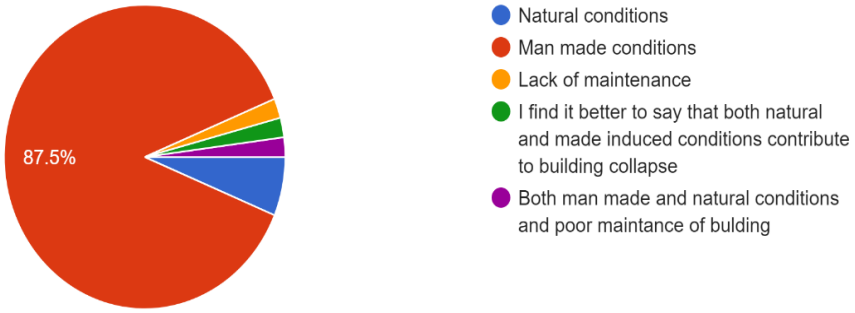

Figure 1: Major cause of building collapse over the decade

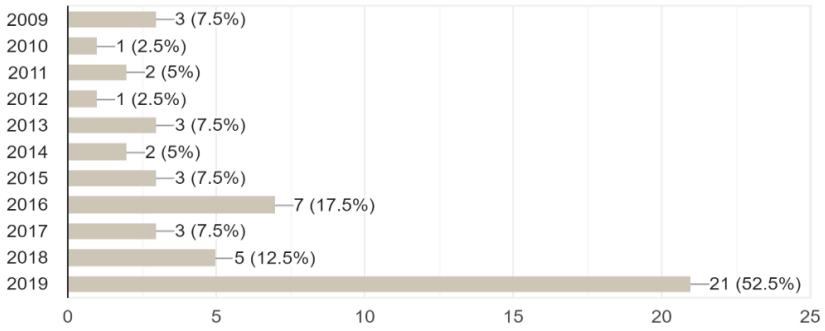

Figure 2: The most amount of building collapse per year.

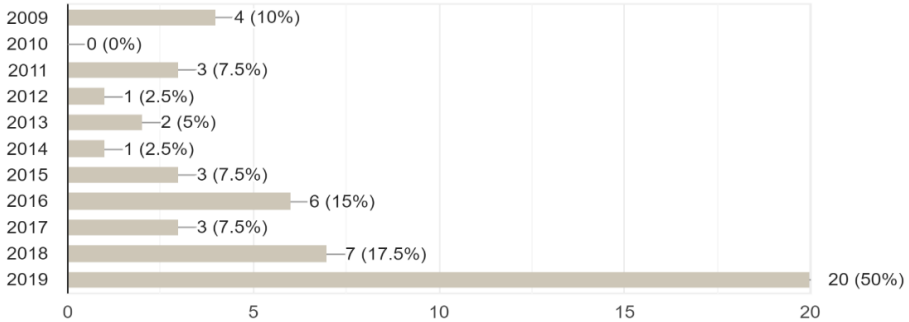

Figure 3: The fatality rate from building collapse per year.

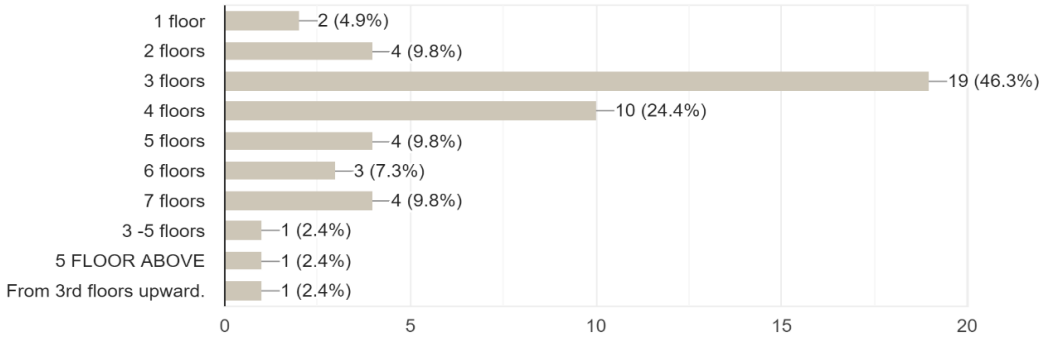

Figure 4: The height of mostly collapsed buildings.

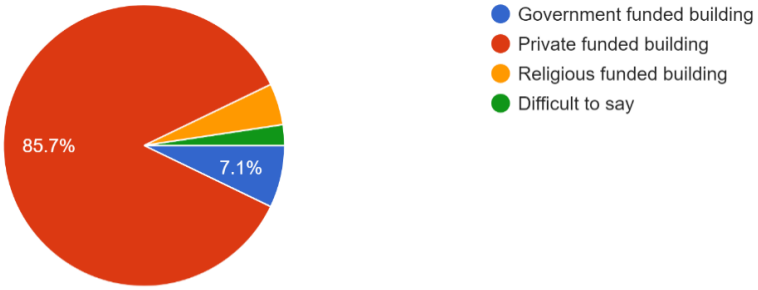

Figure 5: Funding of the collapsed buildings.

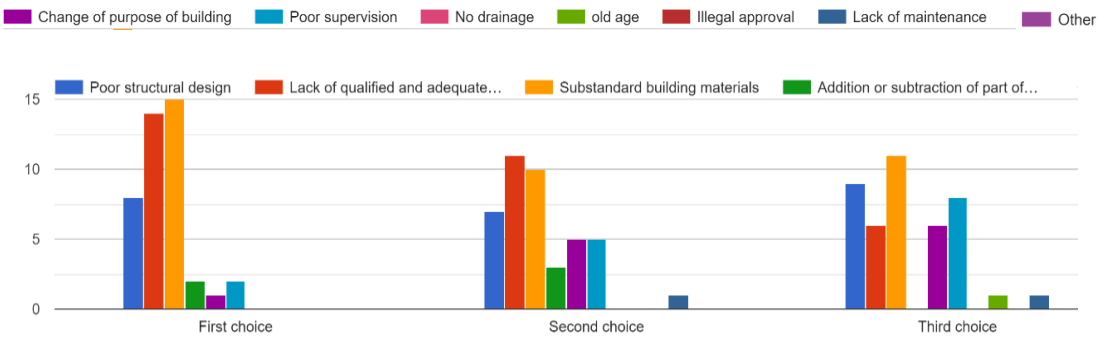

Figure 6: Major man-made causes of building collapse

In addition to these major causes of building collapse, ignorance and greed could also be considered as causes of many of these failures. Religious buildings may also be constructed out of spiritual expediency without factoring actual costs. This, in many cases, could lead to careless designs and compelled supervision out of service to God.

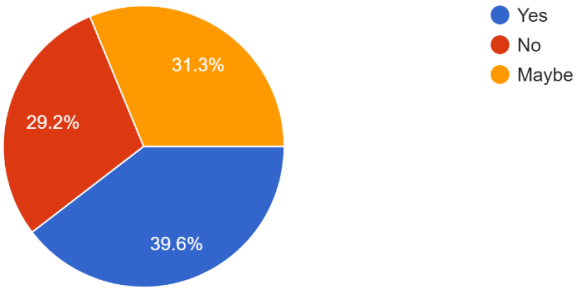

Figure 7: Award of contracts to professionals under registered bodies

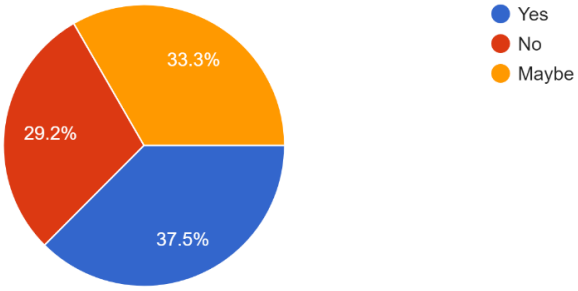

Figure 8: Adherence of professionals to building codes

Although professionals are to abide strictly to building codes, the building codes are also meant to be updated to meet up with the high standard of construction. Figure 9 shows that building codes are not updated regularly in many countries of the world and Nigeria doesn't even have a compiled code for design and practice.

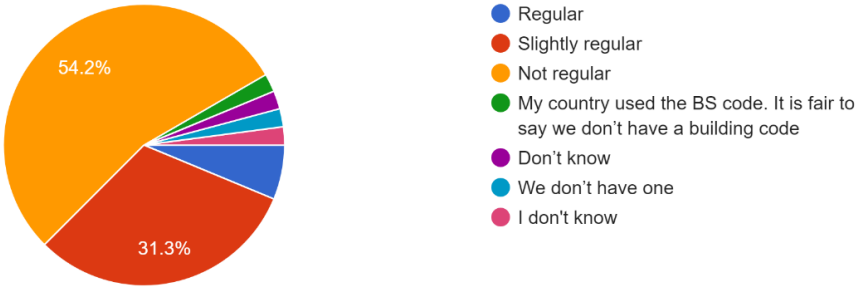

Figure 9: Updating of building codes in countries.

In as much the professionals contributes to the causes of building collapse, the over interference of client on a contract could lead to building collapse. In some cases the clients becomes the contractor while in other cases the contractor listens and obeys the clients instructions forfeiting safety to keep his/her job. In addition, the bribery of law enforcers to achieve construction could result in structural failures.

In providing solutions to the aforementioned causes of building collapse, the use of quality assurance and quality control personnel on a building construction site is highly recommended as shown in figure 10. The quality assurance and quality control personnel should serve as a check on the construction processes, materials, workers and report any fault or foreseen error.

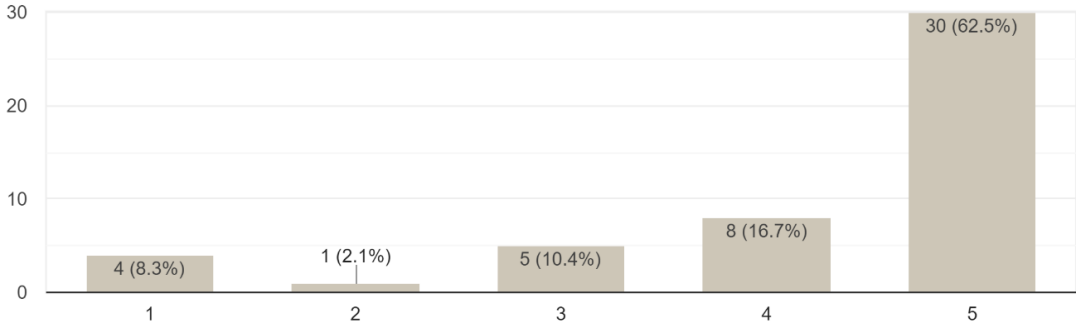

Figure 10: A scale on the importance of quality assurance and quality control personnel on a building construction site

Figure 11, shows that the proper supervision of professionals on site would reduce the structural failures.

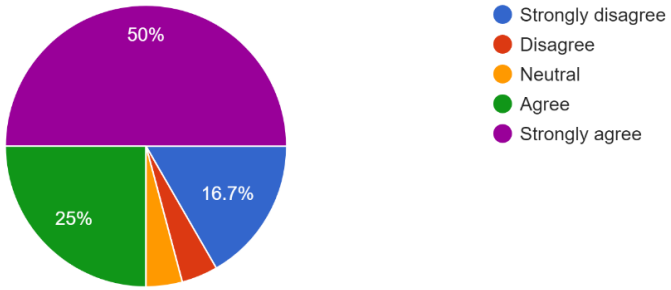

Figure 11: Proper supervion of professionals to reduce stuctural failures

Government agencies also play a significant role in the construction industry, as they are to regulate the codes guiding building construction. The enforcement of penalties on violators should be strongly administered. The design and contractual documents are to be checked thoroughly by government agencies before approval. Lastly, environmental impact analysis and structural analysis should be mandatory.

4. Conclusions

The data from the analysis of the survey carried out show the need for government agencies responsible for construction in Nigeria to enforce quality assurance on every project. Thorough examinations and checks must be carried out during designs and construction by duly certified professionals. Lastly, awareness should be carried out to educate investors and owners of buildings about possible collapse from over interference in the construction process.

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