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

P O Awoyera, J Alfa, A Odetoyan* and I I Akinwumi

Department of Civil Engineering, Covenant University, Ota, Nigeria
*Corresponding Author: abimbola.odetoyan@covenantuniversity.edu.ng

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                   | None     |
| [7]        | 4-storey building | June 2011  | Ndiagu Amechi Road Enugu       | undersized reinforcement,                                  | 3        |
| Reference | Type of Building | Date | Location | Issue | Status |
|-----------|-----------------|------|----------|-------|--------|
| [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 Abua | 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](image1)

![Figure 2: The most amount of building collapse per year.](image2)

![Figure 3: The fatality rate from building collapse per year.](image3)
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.

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.

Acknowledgements
The authors would like to sincerely acknowledge the Covenant University Centre for Research, Innovation and Discovery (CUCRID), Covenant University, Ota, Nigeria for sponsoring the publication of this article.
References

[1] Ede, A. 2016 Structural Stability in Nigeria and worsening Environmental Disorder: the way forward. The West Africa Built Environment Research Conference (WABER), Accra, Ghana.
[2] Akinyemi, A. P., Dare, G. M., Anthony, A. I., & Dabara, D. I. 2016a. Building Collapse in Nigeria: Issues and Challenges Building Collapse in Nigeria: Issues and Challenges. Conference of the International Journal of Arts & Sciences, 9(1), 99–108.
[3] Mathebula, A. M., & Smallwood, J. J. 2017. Religious building collapses: The heavy price of short cuts in places of worship and pilgrimage site construction. Procedia Engineering, 196(June), 919–929. https://doi.org/10.1016/j.proeng.2017.08.025
[4] Ede, A. 2010 Building Collapse in Nigeria: the Trend of Casualties in the Last Decade (2000 -2010). International Journal of Civil & Environmental Engineering IJCEE-IJENS IJENS I J E N S, 10 (January 2010), 6–32.
[5] Taiwo, A. A., & Afolami, J. A. 2011. Incessant building collapse: A case of a hotel in Akure, Nigeria. Journal of Building Appraisal, 6(3–4), 241–248. https://doi.org/10.1057/jba.2011.1
[6] Clement, O. J. O. I. 2013. Design And Construction Supervision As Structurally Sustainable Tools For Building Failure / Collapse In Nigeria. International Journal of Computer Science and Information Technology & Security (IJCSITS), ISSN: 2249-9555 Vol. 3, 3(3), 271–281.
[7] Nwankwo, S. I., Nwankwo, C. V., & Okafor, M. U. 2015. An Investigation of Incessant Building Collapse in Selected Cities of Nigeria. The International Journal of the Constructed Environment, 6(2), 17–39. https://doi.org/10.18848/2154-8587/cgp/v06i02/37445
[8] Odeyemi, S. O., Giwa, Z. T., & Abdulwahab, R. 2019. Building Collapse in Nigeria (2009-2019), Causes and Remedies – A Review. USEP: Journal of Science and Engineering Production, 1(1), 123–135.
[9] Ajufoh, M. O., Gumau, W. A., & Inusa, Y. J. 2014. Curbing the Menace of Building Collapse in Nigeria. International Letters of Natural Sciences, 168–178. https://doi.org/10.18052/www.scipress.com/ilns.20.168
[10] Windapo, A. O., & Rotimi, J. O. 2012. Contemporary Issues in Building Collapse and Its Implications for Sustainable Development. Buildings, 2(3), 283–299. https://doi.org/10.3390/buildings2030283
[11] Oyegbile, O. B., Tat, T. N., & Olutoge, F. A. 2016. Management of Building Collapse in Nigeria: A Lesson from Earthquake-Triggered Building Collapse in Athens, Greece. 2(6), 36–42.
[12] Michael A., A., Oyewale I. O., & O.A, A. 2018. Assessment of Building Collapse in Lagos Island, Nigeria. American Journal of Sustainable Cities and Society, 1(7). https://doi.org/10.26808/rs.aj.17v1.04
[13] Olokede, O., Ogunde, A., Joshua, O., & Babalola, O. D. 2017. Incessant Building Collapse in Nigeria: A Framework for Post-Development Incessant Building Collapse in Nigeria: A Framework for Post-Development Management Control.
[14] Obodoh, D. A. 2019. Analysis Of The Impact Of Building Collapse Risks In The Nigerian Economy. Environmental Review ER. https://www.researchgate.net/journal/0147-2496