Assessment of Building Collapses in Jos Town, Plateau State Nigeria (2016-2022)

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Abstract: Nigeria is a poor nation. Building collapse contributes to poverty level of the citizens even in periods of economic growth. Visits to the collapsed scenes revealed the pathetic conditions of building owners and users. Many have died and properties worth millions of naira lost. The aim of the study is to assess the reason for incessant collapse of buildings in Jos town and proffer solutions to mitigate future occurrences. The study is based on physical assessment of the collapsed buildings by the authors through visits to sites of collapse buildings hours after reports of collapse and secondary data obtained from literature and national dailies. Relevant information were also obtained from building owners and general public during site visits. Five (5) cases of collapsed buildings were reported in Jos within a span of seven (7) years from 2016 to 2022. The building collapses were attributed to the use of poor quality of concrete, compromise of sizes of frame elements and steel reinforcement, non-compliance with design specifications, lack of qualified and appropriate professionals to ensure quality construction, inadequate design and fabrication of structural elements and illegal increase to storey building without redesign of the building. Other causes of buiding collapse in Jos include non-involvement of relevant and qualified professionals. Private developers shun professionals in order to cut costs but this has led to waste of many lives and properties worth millions of naira. Such unqualified professionals take advantage of ignorant clients to extend their areas of service.

Until building regulations are adhered to and the right professional designs, gives approval to the designs, builds, supervises and gives final approval upon construction, building collapse in Jos will continue to be an issue of concern. It is recommended that regulatory bodies should regularly conduct sensitization and campaign through electronic (radio and television) and national dailies (newspapers) about taken proper measures to reduce the incident of building collapse. They should enforce compliance with approved building plan, use of adequate materials and presence of Structural Engineers in the construction team to ensure frame elements are provided specified in the design. Furthermore, State Houses and National Assembly should promulgate laws that will enhance effective synergy between the state government and professional regulatory bodies like Architects Registration Council of Nigeria (ARCON), Council of Regulation of Engineering in Nigeria (COREN), Council of Registered Builders of Nigeria (CORBON), etc. for effective regulation, domestication of National building code (NNBC) and enforcement of quality assurance and regular supervision.

Keywords: Buildings, Collapse, loss of lives, mitigate, professionals

Introduction

Buildings are basic necessities of life. Every family needs a building to reside in. Apart from residential purposes, buildings are required for educational, institutional, business, assembly, and industrial purposes. They are also necessary for the storage of materials.

While private and public efforts are being made to meet the need for housing, the incidences of building collapses in Jos and Nigeria at large is worrisome. It contributes to poverty level of building owners and users even in periods of economic growth.

Building Collapses in Nigeria's big cities such as Lagos, Port Harcourt and Abuja are being fully reported but little has been done for smaller cities like Jos. For instance, [2, 4, 7, 21] assessed building collapses in Lagos while [8, 16, 18] assessed building collapses in Port Harcourt. Although [13] assessed building failures in Jos Metropolis, their work has not covered up to 2022. In the last seven (7) years alone, not less than five (5) buildings have collapsed in Jos town with consequence loss of lives and properties. The aim of the study is to assess the reason for the collapse of buildings and proffer solutions to mitigate future occurrences. Reports of building collapses will also go a long way in creating awareness about the dangers associated with building collapses.

Literature Review

Collapse is a total or partial failure of one or more components of a building leading to the inability of the building to perform its principal function of stability, safety and comfort [19]. Building collapses in Nigeria are attributed to poor structural design, poor compliance with specifications, use of quacks, poor quality control, use of sub-standard building materials, foundation failure, corruption, illegal conversion/alteration/addition to existing structure and natural disaster [20, 2]. Other causes of building collapse include inadequate monitoring of construction sites by government officials, lack of soil investigations, poor funding by clients, absence of building or planning permit, non-adherence to approved building plans, engagement of incompetent contractors, undue interference of client on building works and fire outbreak [3, 6].

In his study, [9] also found that use of poor building materials for construction purposes, quacks, poor workmanship, environmental challenges, change of building usage, defective building design, meager foundation and unusual load are factors that causes building collapse in Nigeria's major cities of Nigeria (Port Harcourt, Enugu, Kaduna and Lagos). Similarly, [21, 7, 17] attributed bad design, faulty construction, over loading, use of quacks, non-possession and non-compliance of approved drawings, poor supervision by regulatory bodies, lack of political will and influence by policy makers to enforce penalties on erring professionals and developers as the cause of building collapse in Lagos. The studies revealed that building collapse in Lagos resulted into huge loss of lives and properties.
In the same vein, the causes of building collapse in Port Harcourt were identified as foundation and structural failure, poor construction equipment, substandard materials, poor workmanship, non-involvement of relevant professionals, defective design, poor maintenance culture, construction inefficiencies, non-approval of building plans, insufficient resources [18, 8, 16].

Safe buildings may be achieved when relevant stakeholders are properly involved and they perform their roles well. Clients, contractors, architects, engineers and quantity Surveyors should play key roles to actualize their respective obligations during building construction.
A client is a person or organization to whom all parties refer to for finance and direction [5]. He takes decision and funds a building project [23]. He is the owner of the construction project. He is solely responsible for the appointment of the consultant. He is also responsible for the selection of contractors subject to consultant's recommendation.
A contractor is an individual or organization that is in charge of a building project according to specified terms of contract agreement. Contractors are charged with the responsibility of physical erection of the building. The contractor starts his work during the planning or design stage and plays a greater role during the construction stage where they administer the project and organizes all the subcontractors, suppliers and equipment before handing over the project to the client [1].

Architects are registered professionals trained in the art and science of building design, develop the concepts for structures and turn those concepts into images and plans for effective Project delivery [15]. The Architect is the first appointee of the client, who develops a facility as per the design concept and the requirements specified by the client. Architectural designs have not constitute problems that precipitates collapse of building. This is because Architectural designs accounts principally for aesthetics and also because building developers consult Architects in the preliminary design of building.

The Engineers are those professionals who invent, design, analyze, build and test machines, complex systems, structures, gadgets and materials to fulfill functional objectives and requirements while considering the limitations imposed by practicality, regulation, safety and cost [22]. The structural engineers provide design drawings which show the locations, sizes, reinforcement and details of structural elements at their appropriate scales. Building projects ought to be supervised and monitored by a structural Engineer so that frame elements are properly provided as designed and to point out to the contractor areas of deficiency which could be in terms of workmanship and materials. Unfortunately, structural design were lacking in all the collapsed buildings assessed.

Mechanical engineers prepare complete, contract drawings using the same scale as that of the building layout drawings showing the mechanical services needed and their location. The mechanical services include: plumbing, drainage, heating, ventilating and air conditioning, fire protection, process piping and equipment and other special systems necessary. The electrical engineers prepare complete, contract drawings using the same scale as that of the building layout drawings showing the electrical services needed and their location. The electrical services include: lighting and power, electrical services, communication and alarm system requirements, one line diagram and risers and other special systems necessary.

The quantity Surveyor (QS) is one of a number of professionals involved in the construction process and has specific responsibility for project cost control not only through the construction phase but for the whole life of the building [14]. The role of the quantity surveyor is, in general terms, to manage and control costs within construction projects and may involve the use of a range of management procedures and technical tools to achieve this goal.
Designs and even poor designs are translated into real life structures by construction workers such as masons, brick and block lawyers, iron benders, electricians, plumbers, welders and carpenters assisted by laborers on sites. These are supposed to be skilled workers. Unfortunately, many of these personnel lack any basic training to undertake the roles they are engaged in the sites. Lack of skilled construction workers can lead to building collapse, for example, wrong concrete mix can affect the strength of concrete.

Methodology

The study was based on physical assessment of the collapsed buildings by the authors through visits to sites of collapse buildings hours after reports of collapse and secondary data obtained from Nigeria Building and Road Research Institute (NBRRI) reports and national dailies. Relevant information were also obtained from building owners and general public during site visits.

Discussion

Five (5) building collapses are reported in Jos town from 2015 to 2022 that resulted in loss of lives, injuries and damages to properties. The details are presented as follows:

Collapsed School Building at ABU NI'IMA Islamic School Bukuru, Jos South LGA.

The site of the collapsed building was located along Gero Road, Bukuru, Jos South Local Government Area, Plateau State. The building was not approved by Jos Metropolitan Development Board (JMDB). The collapsed building is shown in plate 1.

The building was reported to have collapsed on Sunday 6th September, 2015. Six (6) School children died and twelve pupils were injured in the incident according to NBRRI Report No. 36 (Job, et al, 2016). The cause of collapse was attributed to the use of quacks, inferior concrete and inadequate amount of steel reinforcement bars. There should be proper bonding between the concrete and the steel and these entail a proper concrete and steel grades/strengths as well as adequate surround of the steel with concrete so that there is good grip. Adequate amount of steel reinforcement should be provided as close to the surface of the element as possible so that an undue cracked section does not have to be permitted in the large concrete area.

Plate 1: The Partially Collapsed Building (Job, et al, 2016).

Collapsed Hall/Office Complex for Nigerian Medical Association (NMA) at Gura Zot B, Kwang Jos South, Plateau State, Nigeria

The site of the collapsed building is located at Gura-Zot B, Kwang, Jos South Local Government Area, Plateau State. The site lies in the savannah vegetation belt of Northern Nigeria with coordinates of 9.878°N and 8.918°E. The collapsed building is shown in plate 2. No life was lost in the incident but huge properties were lost. Hard earned funds contributed by the Association's members was wasted. It was so pathetic.

The building was reported to have collapsed on Thursday 6th September, 2018. The building project had been under construction for about four years before collapse. A registered company was commissioned by NMA to design and build the structure. However, the work later became a direct labour under the supervision of a non-registered Architect. The drawings were not approved by licensed professionals neither was the building approved by Jos Metropolitan Development Board (JMDB). According to NBRRI Report No. 44 (Job, et al, 2016), the professional that supervised the construction was a non-licensed Builder. He took advantage of ignorant clients to extend his areas of service to carry out the function of other professionals including structural Engineering and architectural services. The required sizes of beams, columns and foundations were provided as specified in structural drawings. The corresponding areas of reinforcement were also not adequate.

Plate 2: A scene of the Collapse Building Structure (Job, et al, 2019)

Collapsed three (3) Storey Building at Butcher Lane, Dilimi Jos North LGA

The site of the collapsed building is located at Butcher Lane, Pump Street, Dilimi Jos North LGA of Plateau State. The site lies in the savannah vegetation belt of Northern Nigeria with coordinates of 9.922°N and 8.887°E. The building collapsed on Friday 12th of July, 2019. The collapsed building is shown in plate 3. The owner of the building with thirteen members of his family lost their life.

The building was constructed in 2012 with batteries of toilets serving public interest at the ground floor and its top being suspended reinforced concrete slab held in place by beams and columns in between sandcrete block walls. The main soak away/septic tank was placed within the building perimeter. The building status was later changed to a storey building with two suspended floors. The construction of the building was prosecuted without relevant construction drawings and competent professional personnel. There was no approval for the building by the Jos Development Board.

Plate 3: The Building before the collapse (*Source: Punch Newspaper, 2019)*

Collapse of Indoor Taekwondo Gymnasium Roof at University of Jos

Windstorm wreaked havoc at the Naraguta Campus of the University of Jos on 23rd April, 2022 blowing off the roofs a new Indoor Taekwondo Gymnasium. There was no approval for the building by the Jos Development Board. The failure of the roof was attributed to faulty design and fabrication to resist uplift hence the wind was able to completely remove the roof. Further physical inspection showed evidence of inadequate supervision as seen by non-verticality and undulating shape of the columns. The blown off roof is shown in Plate 4.

Plate 4: Blown off roof of the Indoor Taekwondo Gymnasium.
Source: https://www.unijos.edu.ng/WindstormWreaksHavocinUnijos

Collapsed of Building Bukuru, besides Mini Stadium, Jos South Local Government Area.

The building was located near Bukuru Mini Stadium, Jos South Local Government Area of Plateau State. It had a supermarket on the ground floor with offices upstairs. The collapsed building is shown in Plate 5. No life was lost in the incident but properties were lost including the supermarket properties.
There was no approval for the building by the Jos Development Board also no involvement of qualified professionals in the design and construction of the building (Ketkukah, et al, 2022). The professional that supervised the construction was a non-licensed Architect. He took advantage of ignorant client to extend his of service to carry out the function of other professionals including structural Engineering services. Inadequate sizes of framed elements were used. There

also seems to be a problem of use. The building plan might be initially designed for residential purposes was turned into multipurpose and illegally increased to one storey building without redesign of the building. This was evidence from additional columns introduced during the construction of the upper floor.

Plate 5: The Building collapse near Bukuru Mini Stadium, Jos South, Plateau State).

(Source: https://dailytrust.com/storey-building-collapses-in-jos/#:~:text=08%3A41%20WAT-,A%20storey%20building%20collapsed%20in%20Bukuru%2C%20near%20Jos%2C%20Plateau%20State, 2022)

Conclusion

Five (5) cases of collapsed buildings in Jos town resulted in loss of lives and properties. All the collapsed buildings had no approval from the State Development Board. While some people believe that incidences of building collapse is due the use of poor building materials during construction by contractors others blame Engineers for poor designs and construction. There are a whole lot of stakeholders in building construction who must perform their roles in order to deliver safe and durable buildings.

The study showed that lack of structural design, use of poor quality of concrete, non-compliance with approved building design, inadequate sizes of framed elements and lack of qualified and appropriate professionals to ensure quality construction are the causes of building collapse in Jos. Other causes of building collapse in Jos include, defective design, defective construction, use of substandard materials, absence of building or planning permit, corruption, non-adherence to approved building plans, absence of proper site and soil investigation, engagement of inexperienced personnel to take charge of construction work, engagement of ill equipped and incompetent contractors, fire outbreak, natural occurrences, lack of proper supervision, inspection and monitoring of construction works and illegal challenges of use, for example, transfer of building plans designed for residential purposes are turned into multipurpose and sometimes an illegal increase in the number of storeys of a building without any recourse to the redesign of the foundation). Adequate amount of steel reinforcement should be provided as close to the surface of the element as possible so that an undue cracked section does not have to be permitted in the large concrete area. There should be proper bonding between the concrete and the steel and these entail a proper concrete and steel grades/strengths as well as adequate surround of the steel with concrete so that there is good grip.

The study also revealed non-involvement of relevant and qualified professionals in all the collapsed buildings. Private developers shun professionals in order to cut costs but this has led to waste of many lives and properties worth millions of naira. Such unqualified professionals take advantage of ignorant clients to extend their areas of service.

Recommendations

1) Standard Organization of Nigeria (SON) and Professional bodies such as (NIA, ARCON, NSE, COREN, CORBON, TOPREC, NIB. NIQS, etc) should regularly conduct sensitization and campaign through electronic (radio and television) and national dailies (newspapers) about taken proper measures to reduce the incident of building collapse. During their annual conferences, seminars, lectures and other forums, professional bodies should highlight dangers and penalties associated with building collapse.

2) In addition to Architectural and Engineering Drawings, structural analysis report and soil tests should be made requirements for approval of building plan.

3) Regulatory bodies should enforce compliance with approved building plan, use of adequate materials and presence of Structural Engineers in the construction team to ensure frame elements are provided specified in the design. In-situ concrete cube tests and tensile test on reinforcement bars should be enforced at sites. Erring developers, contractors and professionals members must be properly investigated and if found not to have complied with the basic rules laid down by their bodies should be sanctioned.

4) State Houses and National Assembly should promulgate laws that will enhance effective synergy between the state government and professional regulatory bodies like COREN, CORBON, etc. for effective regulation, domestication of National building code (NNBC) and enforcement of quality assurance and regular supervision.

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