
AN INVESTIGATION ON THE CAUSES OF BUILDING COLLAPSE IN NIGERIA

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ABSTRACT

The paper examines the causes of building collapse in Nigeria. The objectives are set to determine the general causes of some building collapse and to evaluate the extent of loss in terms of life and properties. The paper attributes the rising incidents of building collapse to the use of substandard building materials and incompetent professionals in construction activities, inadequate supervision, faulty building foundation, the refusal of the wider society to recognise professionalism and pay for the services and the attitude of the building contractors and other stakeholders as the major problem. The paper asserts that promoting or achieving an enduring safety culture in building involves designing, constructing and using buildings in such a manner as to make the building safe for occupation and for carrying out all desired activities. Strategies for ameliorating the trend are suggested. The paper posits that the professionals responsible for designing and monitoring construction as well as the government, manufacturers and the contractors have great roles to play in other to reduce and avert this trend.

Keywords: Causes, Building Collapse and Nigeria.

INTRODUCTION

The frequency of collapse of building structures in Nigeria in the past few years had become very alarming and worrisome. Many lives and properties have been lost in the collapse of buildings mostly in Port Harcourt, Abuja and Lagos. Many property owners have developed high blood pressure and some have been sent to an early grave. A visit to the collapsed scenes were as revealing as they were pathetic and one could not but wonder why such buildings could have been allowed to stand or to what extent people can go to cut corners at the expenses of respect for safety and lives. Unfortunately, there are still a number of buildings of similar circumstances dotting the skyline of many cities in Nigeria, building collapse incidence are still regularly occurring despite increasing diffusion of engineering knowledge over the years calls for some reexamination of developments in building production and control process. As observed by Adeniyani in (2002) why must a preventable incidence continue to traumatize us all the time? These incidents have brought to question, the effectiveness of building contractors in the country. The menace also casts a slur on the competence of the nation's building community of architects, structural engineers and builders – who are the professionals responsible for designing and monitoring construction works at building sites. These professionals are being attacked from all angles because of the recurring incidents of building

collapse. But the building professionals should not bear the blame alone. This is because, firstly, it has been proved that owners of building under construction derail from their approved plans relying more on imagination and fantasy. Secondly, the approving authorities are also known to fail to monitor compliance with approved plans. Thirdly, some building owners shun professionals in order to cut costs. Fourthly, the high cost of building materials has led greedy contractors with eyes on profits, to patronize substandard materials. These short-cut measures have contributed immensely to the occurrence of failed buildings in the country.

BASIC BUILDING REQUIREMENTS

Ogunsemi (2002) disclosed the basic requirements that a building must satisfy. Each and every member of a structural system should be able to resist, without failure or collapse, the applied loads under the service conditions. In other words, it must possess adequate strength. This demands that the materials of the structure must be adequate to resist the stresses generated by the loads. The shape and size of the structure must also be adequate.

The components of the structure should be able to resist deformation under loading conditions. Deformation implies a change in size and shape when a body is subjected to stress. This means that the component should possess adequate stiffness. Thus; the stiffness of a beam or column is a measure of its resistance to bending or buckling. A material or structure that is very strong but lacking in stiffness will so much deform that it will not be able to resist applied loads.

All the structural members of the building must be firm, otherwise the whole structure is assumed to be unstable. Structural stability is needed to maintain shape since it is the ability of a structure to retain under load, its original state of equilibrium. It can mean anything from resistance to sliding, overturning, partial or complete collapse. Any phenomenon that can alter the load carrying behavior of a structure, if not properly taken care of can lead to instability; a condition in which the support reaction is less than applied load. Thus to ensure stability, loads must be balanced by reactions, and the moments due to loads must be balanced by the moments due to reactions. Any building that cannot withstand the load applied upon it will show signs of distress which may lead to failure and invariably total collapse. The possibility of building collapse should not be underestimated. Its occurrence is usually accompanied by loss of properties and lives. A building may collapse when one or more of its essential components fail. When buildings collapse, professional bodies such as Architects' Registration Council of Nigeria (ARCON), Council for the Registration of Engineering in Nigeria (COREN), and even Governments usually set up panels of enquiry to determine the immediate and remote causes of such failures and if possible recommend sanctions against those culpable.

The rate of collapsed buildings in Nigeria has been a source of serious concern to professionals, like Architects, Builders, and Structural Engineers. Building collapse has so often been associated with structural failures. Therefore, structural failures, no doubt, are very dangerous and should be avoided using all necessary precautions

and machineries possible. Ultimately, the effect of collapse of a building structure, particularly at its completion stage and when it is occupied by users is devastating on human lives. Even if lives are not lost, much financial investment is wasted. Once the specifications of the building including its materials and components are not complied with during construction, the result is building failure.

CAUSES OF BUILDING FAILURES OR COLLAPSE

Collapse according to the Dictionary of Architecture and Construction refers to mechanical failure. Collapse is a state of complete failure, when the structure has literally given way and most members have caved-in, crumbled or buckled; the building can no longer stand as originally built. It can be seen therefore, that collapse is very extreme state of failure.

- i. **Inadequate Preliminary Works:** Preliminary works are operations which include site investigation and foundation. Building collapse is imminent where these operations are carried out shoddily. Site investigation is to determine the properties of the soil strata. Seeley (1987) said that all potential building sites would need to be investigated to determine their suitability for buildings and the nature and extent of the preliminary work that would be needed. Particular attention should be given to the nature of the soil and its probable load-bearing capacities, as there may be variations over the site. The past history of the site should be investigated with particular reference to the former existence of trees, water level, borehole log, underneath soil strata and waste dumps. A careful study should be made of adjacent structure to ascertain whether failure can result due to localized conditions. According to Bell (1987), soil is an unconsolidated assemblage of soil particles between which voids. These voids may contain water, air or both. Soil is derived from the breakdown of rock materials by weathering and erosion and may have suffered some amount of transportation prior to deposition. Neville and Chatterton (1987) asserted that the development of soil mechanics which relates to the understanding of the physical properties of any particular soil type in relation to loads was really the main stepping stone towards a scientific approach to foundation problem and construction. However strong, rigid or structurally stable a building may be, its satisfactory performance depends exclusively upon the ground which supports it. Adequate site investigation prevents the issue of foundation problem because it would ensure that the most appropriate foundation is prescribed.
- ii. **Adoption of Wrong Foundation:** Lambe and Whitman (1979) defined foundation as the part of the structure in direct contact with the ground and which transmits the load of the structure to the ground which plays an important role in the construction of building structures. Foundation is expected to carry all the dead, super-imposed and wind loads from a building to the soil on which the building rests in such a way that settlement of the structure is limited, so that failure of the underlying soil is prevented. The depth of soil strata in response to the loadings from the structure has to be located properly in order to safely bear the foundation of the building. Otherwise, the structure will fail.

- iii. **Poor Concrete Mix Ratio:** Usually concrete is a mixture of cement, sand, gravel and water in definite proportion. In providing support for a building, concrete is the most common material used in Nigeria. Tomilson (1980) reiterated that poor materials do not make good concrete. The cement, sand and stone must all be sound and have the types and qualities specified. The result of poor concrete works is building collapse. The steel reinforcements are embedded in concrete, so that compressive stresses are taken by concrete, while tensile stresses are catered for by steel reinforcements. For this purpose to be fulfilled, steel rods must be bent in accordance to design. Otherwise, it will fail and cause collapse.
- iv. **Improper Walling:** the wall is a very important part of the building that also provides support. Other function is to enclose or divide space. A wall that will adequately provide support is a load-bearing wall which must provide adequate strength and stability, weather resistance and durability. The commonest walling material in Nigeria now is sandcrete blocks of various sizes. As a matter of fact, walls which provide support to buildings must be straight, perpendicular and produced of sound materials. The appearance of a crack line in a building is a sign of failure. Failure in block-laying may lead to eventual collapse of the building.
- v. **Lack of Approved Structural Design:** According to Ataev (1985), the basic requirement of any structural component of a building is that it should be strong enough to carry and support all possible types of loads to which it is likely to be subjected. Therefore, building design is not just the Architectural design; it also includes structural, electrical and mechanical engineering. A building that is poorly designed structurally will eventually collapse. The final object of structural analysis is to enable the Engineering design and construct a building structure, which is satisfactory in service, and that such design must be approved by the approving body. This means that it must not collapse when loads are applied and the deformation must not be excessive. In addition, some clients, in order to try and save cost, patronize quacks to do designs for them. This is very common in Nigeria and such designs are grossly inadequate and usually result in building failure.
- vi. **Poor Building Material Specification:** the uses of poor building material specifications have been possible root causes of collapse. In buildings, the materials that are essentially used on construction sites are cement, sand, gravel, granite chipping, timber, iron rods and sandcrete blocks. Other materials are aluminium, glass and ceramics. Good building constructions are enhanced by materials of good quality. Proper handling and storage must be given to building materials. Materials specifications must relate exactly to the intended construction and must be of adequate standard. Specifications are to prescribe what materials should be used and where there is a deviation, failure, that is, building collapse should be expected.

- vii. **Ineffective Supervision:** Averting building collapse depends largely on effective supervision of works. Hence, improper supervision will lead to the collapse of the building structures. Supervision involves the intricate knowledge of workmanship and materials, while inspection is only to ensure adherence to contract documents, especially the drawings. The object of the supervision is primarily to ensure that employer's requirements as expressed in the contract documents are correctly interpreted and the problems which are bound to arise are satisfactorily resolved. In the case of the building under study, there was no proper supervision for the demolition works.
- viii. **Climate:** Apart from failure arising from negligence or negligent behaviour, many of our buildings have failed due to persistent incidence of weather. Ogunsemi (2002) remarked that a good building is not that which merely fulfils the purpose for which it is designed and erected, but a building comely and able to withstand the onslaught of weather conditions.

Other factors are: poor workmanship, use of substandard and poor quality building materials, wrong conversion of building, lack of qualified and appropriate professional, inadequate quality control, fire disaster, bomb explosion, lack of maintenance culture, natural disasters.

BUILDING COLLAPSE IN NIGERIA

In recent times, building collapse in Nigeria has been a source of concern to so many people particularly those associated with the building industry. This is so; because there are so many cases of building collapse all over the world and particularly Nigeria. Most of these cases had resulted into colossal economic losses in terms of lives and property. Building collapse are some of the cardinal issues, which have created serious concern to all the professionals like Architects, Structural Engineers, and the Builders. The government also is worried about the frequency of collapse of buildings Nigeria. However, Aderibigbe (2001) admitted that the recurring event of collapse of buildings has forced some state governments to enforce and enact some laws recommending forfeiture of such buildings and prosecution of their owners. Table 1 shows some occurrences of building collapse in Nigeria in the 70's and 80's, while table 3 shows such cases from year 2000 to 2012.

Table 1: Showing a List of Available Records of Collapsed Buildings within the Last Two Decades in Nigeria

Dates of Incident	States	Types of Buildings	Number of Lives Lost / Injured	Remote Causes
Dec, 1976	Ondo	1 storey	8 died	Sub-standard building
May, 1977	Oyo	2 storey	10 died	Material / structure
June, 1977	kaduna	School building	16 died (several injured)	Poor workmanship by contractors
Oct, 1977	Borno	4 storey	10 died	Poor performance by contractor
March, 1978	Rivers	4 storey	16 died	Lack of concrete services to hold foundation
June, 1982	Ondo	2 storey	7 died	Heavy down pour/structural defects
Sept, 1983	Lagos	2 storey	8 died	Structural defects
Dec, 1983	Lagos	4 blocks of flats	6 died	Heavy down pour
July, 1985	Lagos	3 storey	9 died	Heavy down pour/structural defects
May, 1987	Lagos	3 storey	4 died	Structural defect/poor building material
Sept, 1987	Lagos	3 storey	8 died	Structural defect/poor building material
Nov, 1988	Lagos	School building	1 died (others injured)	Sub-standard building materials
June, 1990	River	School building	50 died (several injured)	Defective structural design
July, 1991	Kano	1 storey	3 died	Sub-standard building materials
July, 1991	Sokoto	1 storey	4 died	Heavy down pour/structural defects
Aug, 1991	Lagos	2 storey	10 died	Poor workmanship/structural defects
March, 1992	Lagos	3 storey	10 died	Structural defects
June, 1992	Lagos	Hotel building	2 died (several injured)	Defective structural design
Oct, 1993	Kano	1 storey	5 died	Dilapidated structures
March, 1994	Oyo	2 storey	4 died (11 injured)	Structural defects
June 1994	Lagos	3 storey	17 injured	Sub-standard building materials
Aug, 1994	Kwara	1 storey	2 died (6 injured)	Structural defects / poor workmanship
Aug, 1994	Oyo	2 storey	10 died (74 injured)	Structural defects / sub-standard materials
June, 1994	Lagos	4 storey	4 died (several injured)	Structural defects/poor building materials
Aug, 1994	Ondo	1 storey	1 died (several injured)	Structural defects
Jan, 1995	Lagos	6 storey	1 died	Structural defects / sub-standard materials

Source: Boye Ajai – 1995 Factors Responsible for Collapsed Building P.19. Tell Magazine No.3. January 16th 1995 Culled from S.O. Izomoh (1997) the Provision of Housing and Management in Nigeria P.20.

Table 2: Available Statistics of Collapse Building in Lagos Since 1982-1996

S/N	Month	Year	Types of Building	Lives Saved	Live Lost	Possible Causes
1	March	1982	Three storey	No record	10	Weak foundation
2	June	1982	Two storey	"	7	"
3	Sept	1983	Two storey	"	8	"
4	May	1985	-	"	9	Faulty foundation and bad workmanship
5	June	1985	Two storey	"	5	Weak foundation
6	July	1985	Three storey	"	9	"
7	Nov	1986	-	"	1	Faulty foundation and bad workmanship
8	May	1987	Two storey	Many people escaped	4	Faulty foundation and bad workmanship
9	Sept		-	Many people escaped before arrival of fire service	7	Structural defect
10	Nov	1988	School building	-	-	
11	Feb	1989	-	It is believed that many people escaped	-	Faulty foundation and bad workmanship
12	May		Uncompleted hospital building	-	-	-
13	June	1994	Uncompleted 4 storey building	It is believed that many people escaped	1	Removal of form work before curing of concrete decking
14	May	1996	Uncompleted church building	Many people escaped	3	Bad workmanship

Source: Federal Fire Service, Lagos and Lagos State Fire Service – Ikeja

Table 3: Showing Recent Occurrences of Building Collapse in Nigeria

S/N	Building Location	Date	Suspected Causes	Remarks (Life Lost)
1	Mushin, Lagos	2000	Faulty construction	Nil
2	Oke-Bola, Ado-Ekiti	2000	Poor quality control, rain storm	Nil
3	Ogbagi Street, Ikare	2001	Fire disaster	Nil
4	Odo Ikoyi, Akure	2001	Foundation problem	Nil
5	Odososo Compound, Ikare	2002	Fire disaster	Nil
6	Ojuelegba, Akure	2003	Poor workmanship and under-reinforcement	Nil
7	Stadium Road, Akure	2003	No structural members	Nil
8	Onyearugbulem Market, Akure	2003	Poor workmanship and under-reinforcement of the cantilevering end	Nil
9	Ebute Meta	2003	Structural defect	8 injured
10	Elias Street, Lagos	2004	Rain storm	8 died
11	Iponri	2005	Inappropriate foundation	Nil
12	Oke Suna, Lagos	2005	Structural degeneration	1 died
13	Broad Street, Lagos	2006	Rain storm	Not disclosed
14	Ebute Meta	2006	Structural defect	37 died
15	Oworonsoki	2006	Faulty construction	1 died
16	Abuja	2008	Faulty construction	3 died, 10 injured
17	Apongbon	2008	Structural defect	3 injured
18	Ikeja	2008	Faulty construction	Several injured
19	Alade Street, Lagos	2008	Structural defect	3 died, 5 injured
20	Ojerinde Street, Idiaraba	2009	Excessive loading, faulty construction	9 died, 3 missing, 21 injured
21	Ajgunle, Apapa Lagos	2009	Structural defect	Not disclosed
22	Abuja	2010	Faulty construction	Not disclosed
23	Garki, Abuja	2010	Overloading	23 died, 10 injured
24	Kano	2011	Rain storm	6 died
25	Abuja	2011	Overloading	100 died
26	Abuja	2012	Unsupervised demolition	2 died

Source: Fakere (2005); Nigeria Daily Newspapers (2000-2003); Ogunsemi (2002) and Oke (2009).

RESULT OF FINDINGS

The incidents of building collapse witnessed in the country in the recent years has resulted in the loss of many lives and the destruction of properties worth several millions of naira; as reflected in the table 1, 2 and 3 below. Many families have been traumatized and many developers have lost their life investments. From table 1, it can be inferred that between 1975 and 1995, about 26 incidents; which claimed about 226 lives were recorded in Nigeria. Table 2 reveals that between 1982 and 1996, Lagos State alone recorded about 14 incidents and about 64 dead. While in a period of twelve years (2000 – 2012) as reflected in table 3 about 26 incidents were reported which claimed the lives of about 196 people. In all the cases, many people were injured and some permanently disabled. According to Sun Diata Post Newspaper, NAN report on collapse of building presented to Governor Babatunde Raji Fashola last year (2013); reveals that no fewer than 135 building collapse in 2013 and another case of building collapse on 2nd January 2014 was recorded.

From the tables above collapse of building can be trace to the following factors

- Overloading of foundation
- Poor supervision
- Faulty and inadequate design
- Poor workmanship
- Structural defect e.t.c

CONCLUSION AND RECOMMENDATIONS

This study has been able to identify several causes of building failure in Nigeria. It has highlighted several case studies of building failure in Nigeria including casualties of those incidents. This phenomenon dates back to just over a decade after the country's independence. The losses always experienced as a result of building failure are enormous; ranging from loss of lives, several forms and degrees of injuries, loss of properties, etc. The National Building Code is a very important document which will greatly reduce the occurrence of building failures in Nigeria. It is always better to prevent building collapse than to try and salvage an already problematic situation.

The following recommendations will help reduce the incidence of building collapse in Nigeria:

1. All clients or building developers should be compelled to comply with approved building regulations before the construction and demolition of their buildings and that all building construction works should be well designed and supervised by a registered member of Architects' Registration Council of Nigeria (ARCON), Council for the Regulation of Engineering in Nigeria (COREN) and Council of Registered Builders of Nigeria (CORBON). Only competent registered contractors should be employed to execute construction works or projects.
2. The professional bodies should hold regular workshops and Continuous Professional Development Programmes (CPDP) in order to improve the professional competence of members.
3. There should be a law in every state in Nigeria, providing heavy penalties for contractors who fail to have registered professionals in supervisory capacity in major building projects. Systematic inspection of building works should be enforced at the Local Government level and penalties for failure to comply with the building standard regulation should be provided for.
4. All building construction materials like sand, cement, aggregates, reinforcement bars and particularly foundation soil should be tested before commencement of any construction. The mineralogy and alkalinity tests of coarse aggregates should be done to know whether the material contains some percentage of impurities, which deleterious and injurious to cement and reinforcement rods.
5. Government should quickly promulgate a National Building Regulation for the elimination or considerable reduction of the incessant collapse of buildings in

Nigeria and quick response committee for investigating incidents of building collapse should be formed.

6. The law governing all approved structural details of buildings, materials and effective supervision by the local Town Planning Authorities should be enforced and not compromised. Section 30(1) of the Nigerian Urban and Regional Planning Decree 88 of 1992, which demands that no building or structure or any part thereof should be erected, converted, altered or enlarged unless a development permit has been obtained by the owner or his agent from the ministry should be enforced. The Government should fund this board established through the decree so as to ensure adequate monitoring of the building approval and construction in our society.
7. Government should exercise leadership in protecting and enhancing the quality of all the buildings by encouraging and enforcing regular maintenance so as to protect human life and properties.
8. All Government functionaries and building developers should be properly trained and encouraged to always give construction of large scale buildings to competent and registered contractors who will also be supervised by a registered Structural Engineering consultant and Architect who preferably have designed such projects.

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Reference to this paper should be made as follows: Alamu F. Bosede and Gana Matthew Sunday (2014), An Investigation on the Causes of Building Collapse in Nigeria. *J. of Environmental Sciences and Resource Management*, Vol. 6, No. 1, Pp. 12 – 22.
