AN ASSESSMENT OF BUILDING COLLAPSE CHARACTERISTICS AND SUSPECTED CAUSES OF COLLAPSE IN LAGOS STATE AND ABUJA - NIGERIA

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The spate of building collapse in Nigeria has continually been on the increase over the years. This study assessed collapsed building characteristics (such as location, usage, number of floors, and number of casualties/fatalities) and suspected causes of building collapse in Lagos State and Abuja. Charts and percentages were employed as descriptive analysis while Spearman correlation was used to determine the relationship between variables. A sample of 55 cases of building collapse was drawn from the study area. The study found out that residential and commercial buildings were more prone to collapse, the numbers of collapsed buildings have been on the increase, and that structural failure was a major cause of building collapse. It was concluded that suspected causes of building collapse have a significant impact on characteristics of collapsed buildings. It was recommended that advanced laboratory facilities should be made available to conduct autopsies on collapsed buildings which would reveal the minute details of the collapse.

Keywords: buildings, characteristics, collapse, structural failure, suspected causes

INTRODUCTION

Construction industry plays an important role in the process of sustainable economic growth and development of any nation and more than 50% of the gross fixed capital budget in Nigeria normally takes the form of construction output (Wase, 2004). Building Industry (a sub sector of the construction industry) is the most complex of all the industries in the Nigerian economy today (Akindoyeni, 2002). The basis of its complexity is on the fact that all other industries and sectors of the social economy depend on it for the environment in which they operate.

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The building industry has witnessed various unpalatable occurrences in the past recent years. Building collapse has been one of the salient issues and this incident has continued to occur unabated in most major cities of the country.

Buildings serve as shelter for man and his activities in an environment which must be safe for man (Odulami, 2002). However, these same buildings have been posing threats and dangers to people either during or after construction as a result of its collapse. Building construction styles are constantly changing with the introduction of new materials and techniques of construction. Consequently, the work required in the design and construction stages of building involves choosing materials, components and structures that will meet the expected building standards. Failure to attain these standards in materials, design and construction can result in building collapse (Tauheed, 2005).

Building collapse occurs when a building falls down or falls in suddenly, often breaking apart. Any structure will probably give evidence of being unsafe before actual collapse. Building collapse is an extreme case of building failure. Ogunsemi (2002) defines building failure as "an incident resulting from malfunction due to errors of design, workmanship, maintenance or the use of faulty materials". While Kaminetzy (1991) defines building failure as an act of omission of occurrence or performance. He attributes it to lack of success, non-performance insufficiency and loss of strength and cessation of proper functioning. According to Chinwokwu (2000), failures for structural collapse were caused by human mistakes, events due to limitation of knowledge of structural behavior or anticipated environmental phenomena. A study carried out by (Ogunsemi, 2002) showed that poor workmanship and use of substandard material amount to about 37% of the total causes of building collapse in Nigeria.

It is common to hear of building collapse as an everyday issue in Nigeria with its attendant losses of lives and property. The sites of building collapse scattered across the length and breadth of Nigeria is quite alarming that it is unimaginable what effects it will have on the building industry and Nigeria economy as a whole. One could imagine what edifices these buildings would have been if only they were constructed accordingly. Building collapse is a topical issue in several cities in Nigeria. Dada (2002) averred that "building collapse has become a recurring decimal, a worrisome menace, a national nightmare and enduring embarrassment". It has been reported that Nigeria especially LagosState has become the "World's junk-yard" of collapsed buildings worth billions of naira (Famoroti, 2005). It is quite unimaginable that a country blessed with so great potentials in its construction industry can experience such magnitude of building collapse. Udom (2008) affirmed that, as a people, Nigerians have been too careless and carefree with the kind of houses they build. He recalls that before independence, "buildings erected in Nigeria were in compliance with global standards. Surprisingly, from the oil boom of 1970s till now, all manner of illicit activities, unwholesome professional practices have crept into Nigeria system, just as armed robbery came at the end of the civil war. People just

want their jobs done, caring little or nothing for professionalism. With this, substandard, pseudo and sharp practices came in along with quacks who would tell whoever wants to hear that they are Quantity Surveyors or Valuers or even Engineers".

Naturally, shelter in the form of building is amongst the three (3) basic needs of life universally accepted and recognized as essential for life sustenance and survival. The need to provide shelter for man and his daily activities has always been an utmost priority. Udom (2008) further affirmed thatthe Nigerian government has desperately continued to make concerted effort in the area of quantitative (but not qualitative) supply of mass housing through budgetary and policy provisions, but surprisingly, the rate at which the existing ones are collapsing all over the country have assumed an alarming proportion and calls for an urgent attention.

Buildings are meant to provide conveniences and shelter to the people but the same building has become danger traps to some people. Buildings are expected to meet certain basic requirements such as buildability, design performance, cost effectiveness, quality, safety and timely completion (Odusola, Atta and Ayangade, 2002). Ayininuola and Olalusi (2004), point out that the professionals contribute to the building collapse because they undertake building construction all alone without consultation with the rest of the building team. In Nigeria, materials and components are displayed in the market without legal approval number and there are no restrictions to the kind, quality and even the sizes of such materials. Nigerians have been too carefree and careless with the kind of houses they build and have not been enlightened on the implications of substandard building construction. The subject of building collapse is no longer a grey area in research. Large gaps in knowledge still exist as a result of happenings in the building construction industry such as, location of building collapse, usage of building, and number of floors of collapsed building, which have not been fully researched. It is against this backdrop that this study aimed to establish a relationship between building collapse characteristics and suspected causes of building collapse in Nigeria and proffer recommendations based on the findings. The following specific objectives are;

1. To collect, collate and tabulate the reported cases of building collapse according to the characteristics of collapsed buildings (suspected causes of collapse, location of collapsed building, use of collapsed building, number of floors in collapsed building, number of losses in collapsed building).

2. To establish the relationship between the suspected causes of building collapse and the use of collapsed building.

3. To establish the relationship between the suspected causes of building collapse and the number of floors in collapsed building.

4. To establish the relationship between the suspected causes of building collapse and the number of losses in collapsed building.

LITERATURE REVIEW

Concept of building collapse

Building collapse, though a common phenomenon in the world over is more rampant and devastating in the developing countries (Sodare and Usman, 2006). Many cases of building collapse have been recorded in Nigeria and have been observed to cut across all building categories (private, corporate and public). A study carried out by Folagbade (2002), showed that over time, 76% of reported cases of building collapse were private buildings which are more prone to building collapse than all other forms of buildings. Building collapse according to Bamidele (2000) as cited in Ogunsemi (2002) is classified into three (3) categories; Practical collapse, Progressive collapse and Total or sudden collapse.

Structural failures in buildings in Nigeria

There are some serious occasions when structural collapse provides opportunities for designers to learn some new lessons. Engineering failures represent instances when the engineer conjectures are falsified and are therefore central to the growth of the engineering professional knowledge (Oyewande, 1992).

Building failure in Nigeria are attributed as 50% of the causes being due to design faults on design faults, 40% to faults on construction site and 10% to product failure as asserted by Oyewande (1992). Those that are usually first accused of professional negligence are any of the following persons; the architect, structural engineer, the contractor and planning authority officials. The inability of the architect and especially the structural engineer to properly carry out his own part of the work, to see to the fact that the right number and sizes of reinforcements are used, the inability of the town planning authorities to ensure that architectural and structural designs (and structural calculations) comply to design principles before approvals are given, leads to structural failures. Major structural failures of buildings are today remarkably known in Nigeria because many are described in the print media. These failures become known to the public, because someone is killed or seriously hurt, not just to discredit the structural engineer, the builder and the other professionals involved in the collapsed buildings.

Characteristics of collapsed buildings in Nigeria

1. Use of collapsed building

2. Location of collapsed building

3. Number of floors in collapsed building

4. Number of losses in collapsed building

5. Suspected causes of building collapse

1. Use of collapsed building

The usage of collapsed buildings is in form of residential, commercial, industrial and mixed used buildings. Mixed use is a type of building used for a combination of different purposes. Most mixed use buildings discovered

in the course of this research are mostly a combination of residential and commercial purposes. These mixed buildings are more prone to collapse due to modifications, extra load on the weight of structure, and so on.

2. Location of collapsed building

A common consideration in the case study areas (Lagos and Abuja) is the environmental aspect. Commercial viability of a location makes more people want to build houses especially storey structures in area, because more people will jostle for space to exhibit or get contact with their customers or client or have shelter over their head. Some locations are routes to a lot of places so high vehicular and human traffic is usually associated with such places, hence more commercial activities. There will always be influx of people and buildings will keep springing up in these locations. The demand for housing is continually on the increase. Due to this, developers just want to erect structures to meet the demand for housing for all not to taking into consideration the type of foundation to be used, design factors, professional involvement, approval from Town Planning Authorities, adequate supervision amongst other factors. Most part of Lagos state is said to be waterlogged as it is close to the water. The soil in these areas are sandy and loose soil, they are not strong or compacted soils. If the right type of foundation is not used, the building may soon become visibly damp, cracks will be notable, structural failure may occur which will then lead to its collapse. Most of the buildings that collapsed in the Abuja area are majorly due to use of substandard material, non-approval of building plans by Town Planning Authorities and poor supervision. This could be seen in the case of the 4-storey commercial shopping plaza which collapsed in the year 2008 in Abuja. Historically, Lagos state is a very old settlement in which most of the buildings have become dilapidated over time. These structures will need to be audited. Where there is need for rehabilitation or demolition of such buildings, these should be carried out.

3. Number of floors in collapsed building

When the number of floors in a structure is abruptly increased without the improvement in the founding members the load in the member is increased and the tendency is for the supporting columns to fail or the pad foundations fail in bearing. Such failure will be sudden and very disastrous. In other to increase the number of storey of an existing building, the structural Engineer must expose one or two foundations to determine the area of bearing and calculate the new load with a view to determining the possibility of the new load being supported by the existing foundation. Checking the soil bearing capacity via penetrometer test would not be out of place for certainty. Failure to carry out these investigations and load analysis may result in eventual collapse of the structure. Building developers are advised to also insure buildings 2-storey and above.

4. Suspected causes of building collapse

According to (Onyemachi and Uji (2005), causes of building collapse in Nigeria can be classified into two factors mainly;

a. Natural phenomena

b. Artificial/man-made factors

A. Natural phenomena

These may occur in the form of storm, flood, exceptionally high wind or hurricane, thunder, lighting, volcanic eruption and earthquake. These natural phenomena are referred to a "natural disaster" or "the act of God" (Onyemachi and Uji, 2005). From a newspaper survey conducted by Arayela and Adam (2001) on the reported cases of incidents of collapsed buildings in Nigeria, it was revealed that many buildings collapsed as a result of rainstorm. Example includes three-storey residential building, Iju-Ishaga, Lagos (September 1999). No one has power or control over natural occurrence, but may be minimized if Environmental Impact Assessment (EIA) is made mandatory to be made available by all developers or building approval applicants before commencement of any building project construction. This will help to determine the feasibility of constructing the building on the proposed site.

B. Man-made/artificial factors

Arayela and Adam, (2001) produced by listing various types of man-made factors responsible for building collapse. These include the following: -

   i.   Foundation failure

  ii.   Faulty foundation

 iii.   Inadequate brief and design deficiencies

  iv.   Design errors

   v.   Poor quality of building materials

  vi.   Poor workmanship

 vii.   Poor maintenance

viii.   Misuse and abuse of building/modification of building

  ix.   Collapse of building induced by fire

   x.   Improper supervision and monitoring during construction

  xi.   Owner-contractor syndrome

 xii.   Use of non-professionals in building construction

xiii.   Excessively rushed construction

 xiv.   The role of professionals and other participants in the building industry.

RESEARCH METHODOLOGY

A survey-based approach was employed in this study which aimed at bringing together as many reported cases of building collapse in Lagos and Abuja as possible. This approach allows the collection of a wider body of data than would have been possible with any other approach. Only collapsed buildings in Lagos and Abuja were covered in the survey. Lagos is in the Southwest and has in recent times witnessed the most numerous incidences of building collapse. Abuja is located in the North Central Nigeria, and is home to a growing number of buildings collapsed. Both have, at one time or the other, been Federal Capitals of Nigeria. The paper established a relationship between the suspected causes of collapse and characteristics of collapsed building which include number of floors, usage of the building, location of the building, year of building collapse and casualties/fatalities of collapsed buildings. The study covered a time frame of eighteen (18) years (1998-2008). A sample size of 55 cases of building collapse was obtained for the study via purposive sampling technique. 11 Local Government Areas were considered in the study area. Secondary data was collected for this research. The historical data were obtained from newspaper dailies, publications and NEMA. The data were analyzed using charts (for graphical presentations) and percentages as descriptive analytical tool. While Spearman rank correlation was employed as an inferential tool to establish the relationship between the selected variables.

Figure 1: Map Showing Categorized LGAs of 55 cases of Collapsed Buildings in Lagos
Source: Bohr (2006)

RESULTS AND DISCUSSION

Graphical presentation of data

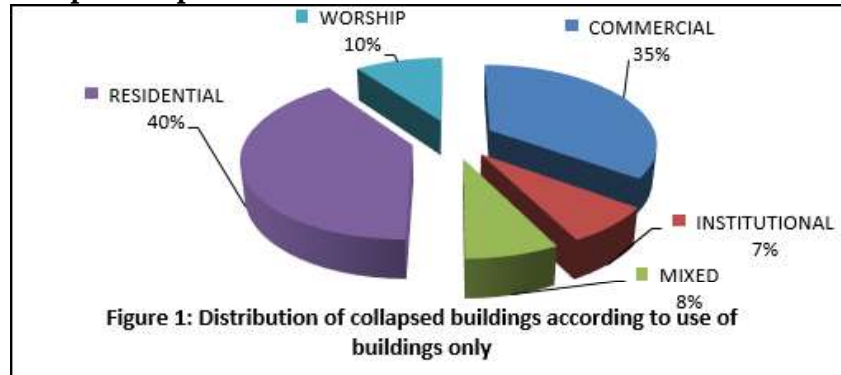Figure 1: Distribution of collapsed buildings according to use of buildings only
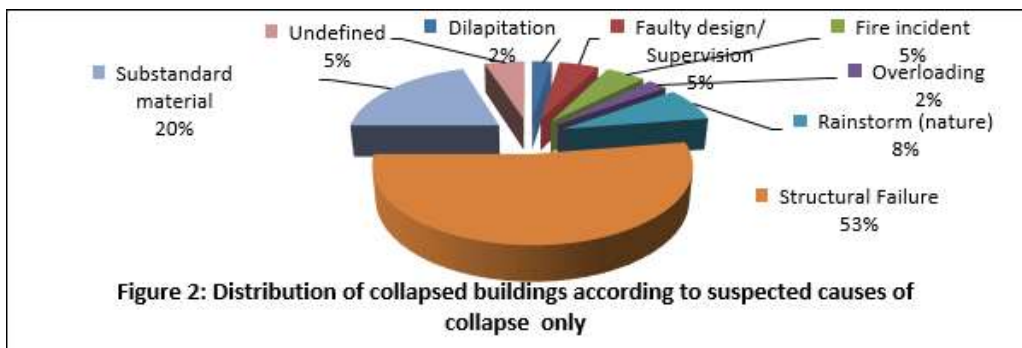
Figure 1, above showed the distribution of collapsed buildings classified according to usage of buildings only. It was observed that 40% were used for residential purposes, 10% for worship purposes, 35% were of commercial usage, 7% were of institutional use and 8% for mixed use. A higher level of threat thus exists towards residential and commercial buildings than other building uses. Common ground might be found in the fact that, in the absence of strict application of town planning laws, conversion of use rife in Lagos, as in most other urban areas of Nigeria. Buildings designated as residential are easily converted to commercial when returns on rents for commercial buildings are higher.

Fig 4.1c: Distribution of collapsed buildings according to local government area only
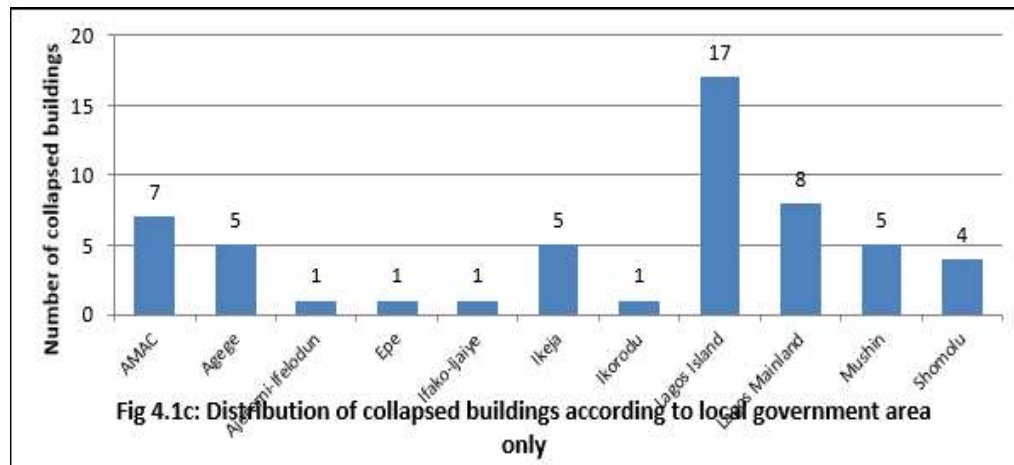
The above analysis in Figure 3, showed the number of collapsed buildings recorded in each Local Government Area. Out of the 55 numbers of collapsed buildings analyzed, 15 buildings collapsed in Lagos Mainland, making it the local government area with the highest number of collapsed building. Epe, Ifako-Ijaiye, Ikeja and Lagos Island LGAs of Lagos state recorded the least numbers of collapsed buildings. 5 buildings collapsed in Ajeromi-Ifelodun and Shomolu LGA. 2 collapsed in Ikorodu LGA, 8 collapsed in Mushin LGA, and 4 collapsed in Agege LGA and Abuja Municipal Area Council respectively.

Fig 4.2: Distribution of collapsed buildings according to year of collapse only
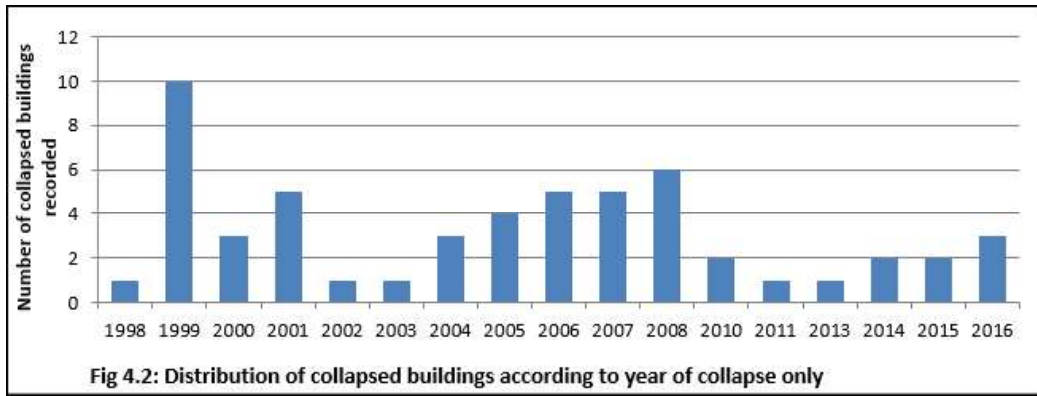
In Figure 4 above, the number of collapsed buildings was classified according to the years that such collapse occurred. 10 buildings collapsed in 1999, which was the highest annual tally recorded. In 1998, 2002 and 2003, the least numbers of collapsed buildings were recorded (1 number respectively). 3 numbers of collapsed buildings occurred in the year 2000 and 2004, 5 numbers on the year 2001, 200, 2007, 4 numbers in the year 2005 and 6 numbers in the year 2008, making 2008 the year with the second highest number of collapsed buildings during the study period. From cursory observation, the trend discernible appears quite worrying. Since 2004, the numbers of collapsed buildings have been on the increase, except for a slight, temporary decline in 2007, 2010 - 2013. Should this trend continue, it would have dire consequences for public safety in the study area.

Figure 2: Distribution of collapsed buildings according to suspected causes of collapse only

The pie chart in Figure 2 above, showed the distribution of collapsed buildings according to suspected causes of collapse. It would be seen from the chart that all the recorded cases of collapsed buildings, 53% were majorly attributed to structural failure showing the highest value of suspected causes, 29% was attributed to substandard material while 2% as the least was attributed to dilapidation and overcrowding.

Figure 3: Distribution of Fatalities and Casualities according to local government areas
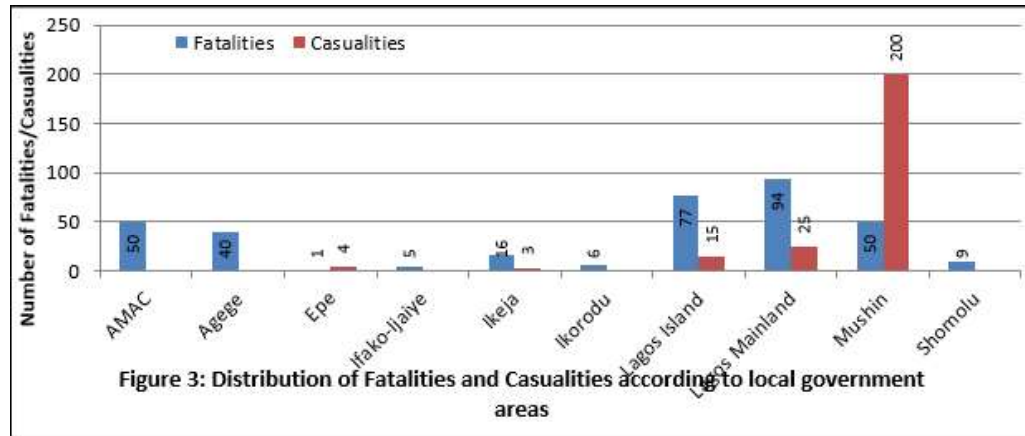
The number of deaths and injured persons recorded in the numerous cases of building collapse that occurred are studied on a location (spatial) basis in Figure 3. The chart showed that Mushin LGA recorded the highest number of casualties (200 injured persons), followed by Lagos Mainland (25) and Lagos Island (15). The foregoing raises issues of a lack of infrastructural facilities within those LGAs where most fatalities/casualties have occurred. Such infrastructures include firefighting stations, good road networks, functional elevators in high rise buildings, fire hydrants and other safety equipment and facilities, well equipped hospitals and well trained Rescue teams. In most cases, the occupants of these buildings are not given any warning signs of the impending collapse of the building, such as cracks in the walls, deflections of slabs and beams, and other types of structural defects. Until very recent times, most LGAs in the study period did not have a disaster management facility or plan. Where trained rescue teams are available, it takes a longer time for them to get to the scene of the collapse. A lack of basic training/techniques in rescue operations is most common however, resulting in death of the trapped victims. This reason has been adduced as part of why the fatalities that occurred in AMAC, FCT numbered up to 50 (Jummai, 2008). Traffic congestion in Lagos state also contributes to the death of some casualties en-route to the hospital for adequate treatment.

In terms of deaths, building collapses in Lagos Mainland (94 deaths), Lagos Island (77), Mushin (50) and Abuja Municipal Area Council (AMAC), FCT (50) recorded the highest figures in that order.The bulk of fatalities/casualties appeared to have occurred in LGAs that have low and medium income earners. The resultant overcrowding might give rise to pressure on and overheating of electrical circuits leading to fire outbreaks which may result in building collapse and death of the occupants. Also worthy of mention is poor development control, observable as improper monitoring/supervision of non-approved structures added by landlords/developers (in the name of "high profit pursuits") on poor foundations. These also usually result in building collapse and deaths of the occupants. The coefficient of determination, (R^2) from the correlation analysis obtained for location and number of casualties was 15.68%; both of these are indicative of poor levels of association between test variables.

Figure 4: Distribution of Collapsed Buildings in Lagos according to Suspected causes of collapse and number of floors in buildings
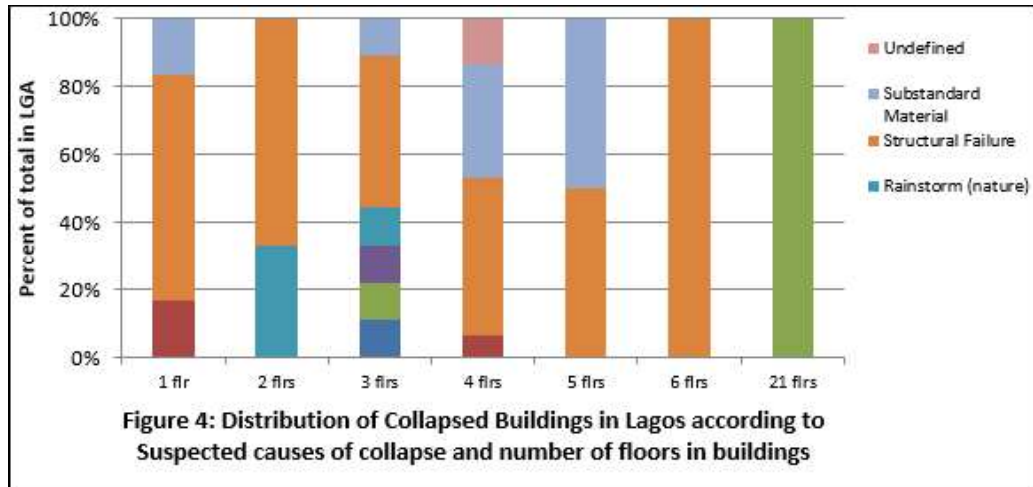
Figure 4, the distribution of collapsed buildings according to the number of floors in the building and the factors suspected to be responsible for the collapses. Undefined causes were observed mainly in buildings having 4 floors. Substandard materials were the leading cause of collapse in buildings having 5 floors. Furthermore, structural failure caused the highest number of collapses in buildings having 6 floors; it was the least important factor in buildings with 3 floors. Rainstorm (forces of nature) was responsible for the most collapses in buildings of not more than 2 floors. The highest number of buildings which collapsed due to overloading had only 3 floors. Fire outbreak was the cause of collapse of a building with 21 floors. Faulty design/supervision was the most important cause of collapse of buildings with only 1 floor. On the basis of height of a building, the suspected causes of collapse in order of importance are: (1) Faulty design/supervision (1 floor only); (2) Rainstorm (forces of nature) (2 floors only); (3) Overloading (3 floors); (4) Undefined causes (4 floors); (5) Substandard materials (5 floors); (6) Structural Failure (6 flrs).

The data gotten for the study were first ranked before using spearman correlation analysis to analyse them. A total of eight (8) experiments were carried out. The value of the spearman correlation was positive and very low. The resulting R^2 value was also low (less than 1%) except in two out of the eight experiments carried out where the R^2 value was above 1% (15.68 & 6.66) %. The value of the probability that the results obtained were due solely to chance was higher than 0.05. It was thus concluded that the dependent variable (characteristics of building collapse) and the independent variable (suspected causes of collapse), do not exhibit any significant levels of relationship (see table 1).

Table 1: Correlation analysis of factors associated with building collapse

Experiment No	Variables X₁	X₂	Spearman Correlation	R^2 (%)	Significance value	Inference
1	Location	Type of use of building	0.068	0.46%	0.675	Statistically non-significant correlation
2	Location	Year of building collapse incident	0.017	0.03%	0.915	Statistically non-significant correlation
3	Location	Suspected causes of building collapse	0.001	0.00%	0.994	Statistically non-significant correlation
4	Location	Number of fatalities	-0.140	1.96%	0.438	Statistically non-significant correlation
5	Location	Number of casualties	-0.396	15.68%	0.379	Statistically non-significant correlation
6	Suspected Causes	Type of use of building	-0.019	0.04%	0.909	Statistically non-significant correlation
7	Suspected Causes	Number of floors	0.258	6.66%	0.108	Statistically non-significant correlation
8	Suspected Causes	Number of fatalities	-0.018	0.03%	0.920	Statistically non-significant correlation

DISCUSSION AND IMPLICATION OF FINDINGS

i. Building collapses appeared to be centred on four LGAs in Lagos (Lagos Mainland, Mushin, Ajeromi-Ifelodun and Shomolu). This could imply that there exist similarities in some collapse-related factors such as the age of housing settlements, the materials employed in settlement construction, the geological nature of the areas, the nature of population-densities in settlements, application of town planning regulations. This is in line with Arayela and Adam (2001) findings. Such similarities, if proven, would point out the direction that further research should pursue. The finding further implies that, at least in the short term, efforts need to be concentrated on residential and commercial-oriented buildings. These usually form the bulk of the housing stock in most urban areas.

ii. From the findings, an upward trend exists since 2003 in the numbers of buildings that collapse annually which has become worrisome. This could be as a result of various factors responsible for this continual occurrence posing threats to the lives of individuals. Should this trend continue it would have grave consequences for public safety in the study area. The need for Research that would allow the accurate prediction of the number of building collapses that would occur annually if this menace is not curbed; is another implication of the finding.

iii. The major cause of structural failure which occurs in these LGA encompasses the problem of Quality Control in the building industry, poor construction techniques, substandard material and

workmanship in the locations of collapse, pervasions and perfections in building regulations, giving rise to collapse of buildings. When a building collapse, most of its structural components and materials will be damaged often beyond re-use, while capital investments in most cases are not recoverable. This kind of situation, more than often leads to bankruptcy on the part of the investor and high economic implications on the nation's economy. Prospective investors/developers are discouraged from investing in projects where these collapses mostly occur. Incessant building collapse is a threat on the sustainable development of the built environment. Adjacent structures are at risk due to vibrations caused by rescue operations. The collapsed site eventually becomes a 'junk-yard' or a 'relaxation spot'. Consideration should be given to the issue of structural failures as it can be combated at the initial stage of construction before actual collapse occurs, if the right equipment and techniques are provided.

iv.   Physical damage and psychological trauma are the aftermath effects of building collapse, the degree of which is often beyond easy prediction. Depending on the nature and extent of damage of building collapse incidents, the effects are felt most in all human endeavours. These effects include loss of human life, and loss of materials and capital investments, as well as psychological pains the rate of fatalities and casualties that occur in building collapse is attributed to poor response of rescue teams who are ill-equipped and technically unskilled in rescue operations. The case can be seen in the collapse of the 5-storey plaza in AMAC, FCT where National Emergency Management Agency (NEMA) was poorly disposed/ ill-equipped to effectively manage the crises and so many people lost their lives even with the presence of rescue teams. Physical hazards, from electrical equipment, noise, vehicles and heavy equipment, sharp objects falling, uneven or unsteady working surface area are major causes of injuries and fatalities at building collapse in rescue operations. These hazards become a severe health risks (cancer, heart burn) after an operation.

v.   Most of the buildings collapsed occurred between 1-6 storeys and above and could be traced to structural failure, substandard material, modification of building and non-approval of building plan. The finding further imply that more attention should be given to buildings above two floors to be on an insurance scheme so as to prevent workers and investment being deployed there assuming for some structural and administrative reasons certain things are not complied with resulting in the partial or full collapse of the building with the attendant economic loss. If insurance is set place, it will minimise the risk involved.

vi.   This analysis is further strengthened by the fact that nearly 5000 houses previously tested by the state government, 300 were found to be structurally defective and hazardous to occupants majorly in Lagos-Island, Ajeromi-Ifelodun LGA, Somolu and Kosofe LGA. Some

of the houses obstructed drainage, leading to flooding in such areas (Olutayo, 2009). The results point towards the probability that the problem of building collapse in Nigeria is actually a problem of Quality Control in the building industry. Most of the major causes of collapse studied in this work could be eliminated with better Quality Control of the construction process. "In an attempt to cut cost, developers resort to the use of low quality materials because of the high cost of building materials" (Adebayo, 2005).

vii. Structural failure was seen to be the major cause of building collapse especially with buildings above 6 floors. This finding is in line with (Oyewande, 1992 and Ogunsemi, 2002; Ayedun *et al*, 2012). The use of a blanket term such as structural failure might not be unconnected with the unavailability of facilities of an advanced nature to conduct autopsies on collapsed buildings. Such post-mortem examination would reveal minute details of the collapse, and the last few hours or days of operation of the building could be recreated and studied. In the absence of such advanced knowledge techniques and equipment, building collapse in Nigeria are usually classified under the blanket term, "structural failure".

CONCLUSION AND RECOMMENDATIONS

The study assessed the characteristics of collapsed buildings (location, usage, number of floors, and number of casualties/fatalities) and suspected causes of building collapse in Nigeria. Residential and commercial buildings were more prone to collapse in the study area. There exists an upward trend in building collapse since the year 2004 which appears quite worrisome. Structural failure was the major cause of building collapse which accounted for majority of the fatalities that occurred. The paper recommends the following:

1. Facilities of an advanced nature should be made available to conduct autopsies on collapsed buildings. Such post-mortem examination would reveal minute details of collapse and the last few hours or days of operation of the building could be revealed and studied

2. Technical education should be encouraged by both the government and the private sectors, so as to ensure training of competent skilled labour (artisans, craftsmen) for building industry in Nigeria.

3. Standard Organization of Nigeria (SON) should strengthen its staff by organizing training seminars and workshops, enhancing its human resources, provision of efficient equipment in order to carry out Quality Control test on building materials; SON should also standardize local construction methods in respect of unique traditional building materials available in Nigeria.

4. This study also realizes that there exists a disaster management facility in the country, but are poorly disposed to manage crisis of high magnitude. The study thus, recommends that these facilities

(FRSC, NEMA, NSCDC, Red Cross Team, and Critical Rescue International) should be provided with adequate equipment to perform in cases of building collapse. Rescue teams should be given basic training in structural performance of buildings, concrete properties, risks, team concepts, tool requirements and rescue techniques/operations. Building designers should be encouraged to prepare a detailed emergency response plans before a building is built.

5. The Nigeria Institute of Town Planners in collaboration with organizations responsible for approval of building plans should monitor buildings that are not approved, unauthorized and addition of extra floors on existing buildings without due considerations with the structural engineers.

6. Soil test, Environmental Impact Assessment (EIA) and structural analysis needs to be made mandatory to be submitted along with the building plans to Planning Authorities by all the developers. This will help the building team to know what foundation type is to be used and precaution to take in order to avoid building collapse due to settlement and other foundation problems.

7. Massive public enlightenment campaign should be carried out by professional bodies in collaboration with regulatory agencies and the media to make the public aware of the implications of patronizing quacks, unapproved design and construction process and to report such cases that might result to building collapse. The cases of building collapse should be reported and documented for further studies.

8. A special Building Collapse Unit (BCU) should be created under the existing statutory Town Planning structures. This BCU should do nothing other than:

   a) Field surveys of the housing stock, using advanced technology to establish the level of "safeness" and "proneness" to collapse.

   b) Maintenance of an electronic database of all properties along with their level of 'safeness'.

   c) Periodic phased demolitions of buildings that have exceeded their useful life. This 'demolition schedule' should be forwarded to Development Control Sections/Departments for appropriate action.

9. Auditing of buildings within Ebute-Metta, Lagos Island, Ajeromi-Ifelodun, Mushin and part of Lagos Mainland (old and new buildings); to ascertain their physical and structural stability. These buildings should be subjected to Non-destructive Laboratory Test and Soil Test. The exercise will afford government to:

a. Avert the collapse of distressed buildings either through appropriate recommendations for their rehabilitation or outright demolition.

b. Publishing of identified buildings in the newspapers for public awareness.

10. Insurance companies should mandate building owners or developers to obtain insurance on the building against collapse and loss of lives and properties.

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