Causes, Effects and Remedies to the incessant Building Collapse in Lagos State, Nigeria

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Abstract-- The factors affecting building collapse in Lagos have been a major concern in Nigeria as it threatens human lives and properties in the state because of its occurrence at close intervals. People erect buildings without considering some factors and codes which are necessary to put in place before embarking on any development and these calls for a reason to emphasize on the remedies to put an end to this disasters. This paper has posited that various factors are responsible for the incessant causes of building collapse in Lagos state, include the use of substandard materials, coupled with the activities of quacks which have inexorably contributed to the incidence of building collapse. In an attempt to find lasting solution to the causes and effects of building collapse in Lagos state, this paper examines types of collapse, as posited by different authors; some of the major causes of building collapse include: bad design, fire, lack of proper supervision, faulty construction and alteration of approved drawings etc. as well as the effects and problems caused by building collapse. Finally, useful suggestions were proffered as corrective measures, also far reaching recommendations were made.

Index Term-- Incessant, Building Collapse, Lagos State, Building Failure, Effects, Cause and Remedies

1.0 INTRODUCTION

In Nigeria like any other countries in the world, building collapse menace is growing at an alarming rate, seemingly uncontrollable or beyond control. The incessant buildings collapse in Nigeria has become a great concern to all the stakeholders and the professionals in the building industry, government, private developers, clients and users, as well as the residents. Fall out of the author’s concern about the increasing incidents of collapse building nation-wide form the basis for this paper to find out the major causes and probable remedial measures to collapse of buildings in Nigeria. Many lives and properties have been lost in the collapse of buildings mostly in Port Harcourt, Abuja and Lagos respectively. Many property owners have developed high blood pressure and some have been sent to an early grave. According to Windapo (2006) “frequent types of buildings that collapse are residential buildings which are either on two, three or four floors.” According to Dada (2002) “Structural Failure has become recurring decimal, a worrisome menace nightmare and an enduring embarrassment”. The horrifying scene of structural failure is no longer news breaker this time around. Really, incidents of collapsed buildings, collapsed bridges or collapsed structures of various types are not peculiar to Nigeria alone. But the current situation is becoming more rampant and embarrassing, most especially as it relates to Lagos State. 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 and this calls for some re-examination of development in building production and control process (Dimuna, 2010).

Research was carried out by Bamidele, 2000 and Fadamiro, 2002 on the causes of building collapse in Nigeria and identified the following five (5) major causes which include; natural phenomenon, design error, procedural error, sub-standard material, poor workmanship, the lack of maintenance, the abuse of use of building etc. Research showed that the substandard material and poor workmanship contribute 45% to the overall causes of building collapse in Lagos State. (Ogunsemi, 2002) added that substandard materials amount to 18.4% of the total cause of building collapse while poor workmanship amount to 19%. Building collapse can be as a result of some defect in building which are not quickly put in place by the property owner such as; fungus stain and harmful growth, erosion of mortar joints, peeling paint, defective plastered renderings, cracking of walls and tearing walls, defective rainwater goods, decayed floor boards, insect or termite attack, roof defect, dampness penetration through walls, unstable/faulty foundation, poor installation of air-condition units etc.

All these defects in building if not properly controlled and maintained, with time can lead to unexpected building collapse (Gafar, 2004). Building collapse have been a serious problem and concern to the government and professionals in building industry as they have been making efforts in their own ways to reduce this incessant collapse if not totally stopped.

Recommendations from earlier studies on the incidence of building collapse in Lagos have revolved around improved individual input from professionals in the building industry, carrying out soil test, building supervision, monitoring of the activities of professionals to discourage quackery among...
many others. However, other areas that need to be looked into include the collaboration of building professionals in ensuring quality delivery of sustainable building construction throughout the construction phases, and the participation of the public in the regulatory role of building construction.

This paper will examine possible factors responsible for building collapse, as well as its effect on the economy and individuals as the views of various authors on building collapse shall be extensively discussed. Also, several remedial measures were examined as a means of solving the incidence of building collapse in Lagos metropolis.

2.0 STATEMENT OF PROBLEM
In the building industry today especially in Lagos, building collapse has been one of the major problem faced by both the private and public developers, whether for personal use and for investment purposes. Lagos metropolis is a city where building collapse occur frequently and has the highest number of building collapse incidents that claimed about 64 lives between 1982-1996 (Dimuna, 2010). In the past thirty seven (37) years (1974-2010), Lagos State has recorded quite a number of cases of building collapse in areas like Ébute-Metta, Lagos-Island, Mushin, Oshodi, Maryland, Ojuelegba, Ikeja, Agege, Idumota, Ketu, Central Lagos, Surulere, etc. as well as Abuja, Port Harcourt, Ibadan, Kano that also has the high number of building collapse cases.

This has posed a very serious challenge to those in the building industry, the government and the individuals who are into property development in the country and in Lagos State. The worrisome development and incidents throw the question that, what might be the cause(s) of building collapse in the state? Several factors have been associated with this, some of which are negligence, greed, deficient foundations, inadequate or faulty steel reinforcement, hasty construction, no soil test, poor supervision and non-adherence to the building codes (Ede, 2010).

All these aforementioned problems and question revolves around the ultimate question that; when will developers in Nigeria begin to follow the appropriate steps and processes before embarking on development and when will the building regulation be standardize by government? If all these are put in place, the problems of building collapse would be reduced to the barest minimum.

3.0 MATERIALS AND METHODS

Study Area
Lagos State was created on 17th May, 1967 by Virtue of State Creation and Transitional Provision Decree No. 15 of 1967, which restructured Nigeria’s federation into 12 states. The state is located on the South-Western part of Nigeria on the Narrow Coastal Plain of the Bight of Benin. It lies approximately on longitude 24°42 East and 3°22 respectively and between latitude 60°22N and 60°42N.

It is bounded in the North and East by Ogun State of Nigeria, on the West by the Republique Du Benin (Republic of Benin) and stretched over 150km along the Guinea Coast of the Bight of Benin on the Atlantic Ocean. The jurisdiction comprises of the city of Lagos and the four administration divisions (The Colony Province of Ikeja, Ikorodu and Badagry on 3,577 kilometre). The drainage system of the state is characterised by a stretch of lagoon and waterways which constitute about twenty-two per cent (22%) or seven hundred and eighty seven (787km) on seventy-five thousand, seven hundred and fifty-five (75,755) hectares of the total land masses. The major water bodies are the Lagos and Lekki lagoon.

However, in examining the history of Lagos, two factors may be mentioned. One is the addition of slave trade and the other, the consequent introduction of the British preventive squadron to patrol the west coast. This helped to increase the risk and cost of Atlantic Slave trade, the traditional west-coast slaving parts and thereby helped the rise of small towns like Lagos and Badagry, which offered the traders relatively safe and cheap part for the evacuation of slaves. See figure 1 below:

![Fig. 1. Map of Lagos State Showing the Local Government Areas](source: Lagos State Ministry of Lands & Survey (2012). In Incidence of Building Collapse in Nigeria: Case of Lagos State by Layi Eggunjobi & Ademola Adebayo)
By 1914, there emerged a single political entity (Nigeria) a central authority (British) and a capital (Lagos). It should be noted that one of the merit of the existence of Lagos was the gradual opening up of the interior for both Missionary and business activities. In Lagos, the industrial and commercial nerve of Nigeria account for over fifth of total population in terms of value added. The primary sector is significant while the real estate practice is one of the largest activities carried out in Metropolitan Lagos.

The state took off as an administrative entity in April 11, 1968 with Lagos-Island serving the dual role of being the state and federal capital. Lagos is an area comprising of 557,700 hectares (17 per cent of which is lagoon and waterways). It is created of the south-west direction of Nigeria and is bounded by Ogun State in the North and East, the Republic of Benin by the west and Atlantic Ocean (Bight of Benin) by the south. It is characterised by flat terrain and gentle slopes and as a result, development becomes tedious due to the presence of poor natural drainage conditions, extensive works to make them suitable for development is limited because of poor area coupled with dense natural vegetation which covers 60% of the total land mass.

Lagos is the smallest in area of all Nigeria’s states, the state is arguably the most economically important state of the country and also the nation’s largest urban area. The actual population of Lagos is disputed between the official figure of 2006 National Population Censuses (which puts Lagos State population at 9,013,534) and 17,500,000 figure as claimed by the Lagos State Government. Average population density of the state is about 2,500/km². Meanwhile, Lagos now happens to be the second most populous city in Africa after Cairo and seventh most populated country in the world. The land use pattern in Lagos is mixed of all forms of land uses; residential, commercial, industrial, recreational, circulation, agricultural and other special services.

Lagos metropolis is adequately planned for as a result; there has been excessive urban sprawl with very few open spaces left in compounds or between buildings. Moreover, there are some general problems peculiar to Lagos metropolis, these problem include the following:

1. Building Collapse (see plates 1,2,3 & 4)
2. Housing problems (qualitative and quantitative) due to low number of habitable residential accommodation
3. High level of insecurity in the state
4. Poor transportation network
5. Inadequate infrastructure and basic amenities
6. Flooding as a result of poor drainage network and blocked drainage network
7. Over-population, this leads to unemployment in the state, also increase in crime rate.

8. Lack of space for development as little vacant space are very expensive due to the allocation of business in the state.

### Table I

<table>
<thead>
<tr>
<th>Class Of Interval</th>
<th>Number Of Cases Within Interval</th>
<th>Annual Average (%)</th>
<th>Aggregate Percentage</th>
<th>Highest</th>
<th>Lowest</th>
</tr>
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<tr>
<td>1978-1986</td>
<td>17</td>
<td>2.45</td>
<td>12.23</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>1987-1992</td>
<td>19</td>
<td>3.8</td>
<td>13.67</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>1993-1998</td>
<td>19</td>
<td>3.8</td>
<td>13.67</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>1999-2000</td>
<td>36</td>
<td>7.2</td>
<td>25.89</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>2004-2008</td>
<td>30</td>
<td>6</td>
<td>21.59</td>
<td>14</td>
<td>1</td>
</tr>
<tr>
<td>2009-2013</td>
<td>18</td>
<td>3.6</td>
<td>12.95</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>139</td>
<td></td>
<td>100</td>
<td></td>
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</tr>
</tbody>
</table>


The table above clearly shows a 35 years trend of building collapse in Lagos, Nigeria. The analysis of the table reflects that between 1978 and 1986, 12.23% of the total number of building collapse occurred with an annual average of 2.45%. Between this period, 1985 recorded the highest frequency, with about 7 cases amounting to over 41% of that time interval. In 1978 and 1984, the lowest occurrence of building collapse was recorded with only 1 reported case (0.72%) observed in each year. The aggregate percentage of building collapse occurrence between 1987 and 1992 and between 1993 and 1998 was the same as well as annual percentage of reported cases within the same period. This implies that, between 1987 and 1992, 13.68% of the total collapse occurred; the same between 1993 and 1998. 1987 recorded the highest frequency of collapse between 1987 and 1992 and 1993 in the state.

The least frequency of 1 case, about 0.72% occurred in 1993. The class interval that witnessed highest number of reported cases was between 1999 and 2000 followed by 2004 and 2008. From 1999 to 2003, there were 36 reported cases representing about 26% of the total occurrence. This implies that annually between this periods, not less than 7 reported cases were observed. 2000 and 2002 had highest frequency between the period, 9 cases, each constituting 25% in the group and over 6% of the total. To further consolidate that highest number of occurrence was between this periods, the least for the class (greatest among the least in other intervals) was 5 cases of collapse, about 4% of the total, occurring in 1999 and 2001. The frequency of occurrence between 2004 and 2008 is also of
particular interest as noted earlier. Between these periods, about 22% of the total collapse occurred with 2006 being the most significant of all the occurrences. 2006 only accounts for a slight proportion over 10% of the entire period (14 reported cases) and close to 65% for the group. The analysis also indicates that an average of 6 cases of collapse was reported annually between the class intervals. Though, there was a sharp drop between 2009 and 2013 as compared with other years, nevertheless, the analysis indicates that close to 4 reported cases, about 20% within the class interval, was recorded annually. The end to this incessant building collapse in Lagos state seems not to have come, as yet another massive structure (religious building) collapsed in 2014 claiming more than 100 lives, some of whom were foreign Nationals. Another recent building collapse in Lagos state was the one that happened in Lekki phase 1 area of Lagos Island claiming more than 5 lives and leaving several others injured. Importantly, some of the factors responsible for building collapse are extensively discussed in the later part of this paper.

Fig. 2. Analysis of distribution of building collapse in Lagos State’s Local Government Areas, between 1978 and 2013.

Source: Lagos State Ministry of Lands & Survey (2012). In Incidence of Building Collapse in Nigeria: Case of Lagos State by Layi Egunjobi & Ademola Adebayo

Also, Figure 2 & 3 below depicts the spatial distribution of building collapse in the Local Government Areas of Lagos state. The dots in the map represent the cases of building collapse in the state as analysed in table 1 & figure 2.

Fig. 3. Showing Spatial Distribution of Cases of Building Collapse in Lagos State (1978-2013)

Source: Lagos State Ministry of Lands & Survey (2012). In Incidence of Building Collapse in Nigeria: Case of Lagos State by Layi Egunjobi & Ademola Adebayo

4.0 DISCUSSION OF FINDINGS

Causes of Building Collapse in Nigeria

Many causes of building collapse have been identified by different scholars. Collapse according to the Dictionary of Architecture and Construction refers to mechanical failure. According to Dimuna (2010), 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. The causes of building collapse can be categorized as;

1. That is caused by the influence of man
2. That occurred due to natural forces (force majeure)
This paper targeted attention to that caused by the influence of man either due to his negligence or incompetence. In a communiqué issued at the end of a two-day seminar on structural failure and building collapse in August 1996; professionals in the building industry summarized the major causes of building collapse to include the following: the attitude of the public, professional bodies and governments. The absence of soil test before construction, structural designs and details are sometimes defective, lack of proper planning, absence of co-ordination between professional bodies and town planning authorities, lack of adherence to specifications by contractors, use of unqualified and unskilled personnel, poor or bad construction practices, use of sub-standard building materials, inadequate enforcement of existing laws. Causes of building collapse as highlighted by Dimuna (2010) are as follows;

- **Deficient Structural Drawing**

Any building have the tendencies to collapse when structural drawings are based on false assumptions of soil strength, they can also collapse as a result of faulty structural details. Oyewale (1992) identified design faults accounting for 50% of collapse of engineering facilities in Nigeria.

- **Lack of Proper Supervision**

Even where a structural design is not deficient, absence of proper supervision on the site by qualified personnel can lead to building failure.

- **Alteration of Approved Drawings**

During construction, many contractors either on the directive of the client or in a bid to cut corners and maximize profit, alter approved building plans without corresponding amendment to structural drawings to the detriment of the structure.

- **Building Without Approved Building Drawings**

Building without approved drawings or even no drawings at all, can result to the collapse of the building. More so, when the drawings were not well vetted by qualified professionals or relevant authorities before the buildings are erected. Consequently, without working drawings, all construction is based on assumptions as earlier said, by this, several errors can creep in and can lead to structural failure.

**Approval of Technically Deficient Drawings**

Town Planning authorities at times approve technically deficient drawings. This may be as a result of ignorance on the part of Town Planning personnel who vet and approved these drawings or as a result of outright corruption on their part. Money may at times change hands resulting in the approval of such drawings.

- **Illegal Alteration to Existing Buildings**

Client at times, on their own, alter existing structures (buildings) beyond and above the original design without any working drawings, and relevant Town Planning approval for such development. In some cases, existing bungalows have been converted to either a storey building or two or three-storey structures without any drawings and supervision by qualified personnel. The result can be anybody’s guess.

- **Absence of Town Planning Inspection or Monitoring of Sites**

In some cases, Town Planning Authority staff seldom visit sites to inspect or monitor progress of approved work in sites, the result of which is documented in their forms. Unfortunately, in many cases, these inspections is non-existent. What this means is that buildings are put up without the Authority knowing anything about the details of the construction. Unfortunately, these details are only known when such buildings collapse and their elements get exposed for all to see. By that time, lives probably may have been lost.

- **Clients Penchant to Cut Corners**

A study of collapsed buildings shows that most of them are residential buildings and owned by individuals. What this meant is that, one person takes all the decisions concerning the construction; due process is not followed. Nigerian client (mostly individuals) have a penchant for cutting corners by not employing qualified personnel to produce the contract documents and supervise the building while under construction, as they want to spend minimum (not optimum) amount of money on the construction (Madu, 2005).

Even where qualified professionals are employed for design and supervision, most clients insist on having the final say on what goes on in the site to the detriment of proper execution of the contract. Unfortunately, if there is any mishap on site, the client put the blames on the consultants and the contractor. It is therefore obvious that client’s penchant to cut corners is one of the problems in the building production process.

- **Use of Substandard Materials**

Substandard material especially reinforcement rods, steel sections and cement can contribute immensely to failure of buildings. Other substandard materials can also contribute to failure of buildings. Hall (1984) posited that use of low quality materials is one of the major causes of structural failure. Aniekwu and Orie (2006) in their study, also identified low quality materials as the most important cause of failure of engineering facilities in Nigeria.
• **Inefficient Workmanship (Labour)**

Inefficient and fraudulent labour input can also contribute to failure of buildings. When a contractor cannot read drawings, or where he refuses to listen to the instruction of the consultant, anything can happen. Oyewande (1992) posited that faults on construction sites accounts for (40%) of collapse of structures.

• **Use of Acidic and Salty Water**

Use of acidic and salty water, as sources from oceans and seas in cities like Lagos and Port Harcourt can affect the strength of concrete when used to effect the mix of cement, and sand and rods.

• **The Activities of Quacks**

The incursion of quacks in the building industry is also a causative factor for building failure. A cursory look at the building industry in Nigeria today reveals a preponderance of individuals who are ill-equipped to carry out functions associated with construction. The industry has had more than its fair share of the activities of quacks and have nothing at stake whenever problems arise. The unsuspecting public is also at a loss differentiating the real professionals from the quacks until the real harm has been done. Today, it is not strange to find staff of Town Planning offices who are mainly Town Planners and Site Inspectors, even some Land Surveyors and Builders taking architectural commissions, and masquerading as architects by deceiving the unsuspecting public. Masons have overnight transformed to engineers and builders. This is a major problem of the building industry.

• **Clients’ Over Reliance on Contractors for Decision Making on Site**

Most client rely on contractors than consultants on site. This is because most contractors are either their friends, relations of the clients, or are recommended by friends or relations. The result of this relationship is that client rely more on the contractors for decision making than on the consultants. What the clients fails to realize however, is that profit is the prime motive of most contractors and not because the contractor is saving them some cost. They end up reducing the thickness of floor slabs and foundation and even foundation depth; sizes of reinforcement rods, head room (height) of structures, all in attempt to maximise profit to the detriment of the construction, and because most clients cannot read drawings, they are “taken for a ride” by most contractors. It is only when building falls that these facts come to the surface. Even for big projects owned by corporate bodies and governments etc., the contractors seem to have special relationship with agents of the clients, some desperate contractors use blackmail and intimidation to scare away and discourage consultants from project sites.

Plate 1 Showing: A Cross Section of a Collapse Building in Lekki Area of Lagos
Source: www.google.com.ng.

Plate 3 Showing: Another Recent Collapse Building in Lekki Phase 1 Area of Lagos on March, 2016, Leaving at Least 5 Persons Dead. Source: www.tori.ng.
Usually, a combination of factors are implicated in the collapse of building as listed above; but the timing of the recent happenings in Lagos and PortHarcourt indicates that the nature of soil is very central to the main culprit in building collapse, as these are happening especially now in the rainy season. More attention should therefore be given to geotechnical investigation for high rise structures in areas with soil that are very suspect and the water table is high. Onitsha town is a good example of where such high rise buildings are the norm, but so far, no building collapse has been reported. The reason is that the soil bearing capacity is very high in most areas of the town. Also Divid (2009) identified the following; as causes of building collapse, they are as follows;

a. **Bad Design:** This does not mean only errors of computation, but a failure to take into account the loads the structure will carry, erroneous theories, reliance on inaccurate data, ignorance of the effect of repeated impulsive stresses, and improper choice of material or understanding of their properties. The engineer is responsible for these failures, which are created at the drawing board.

b. **Faulty Construction:** This has been the most important cause of structural failures, the engineer is also at fault. Here, if inspection has been lax (i.e. not strict, severe or careful enough about work, rules or standard of behaviour). This includes the use of salty sand to make concrete, the substitution of inferior steel for specified one; bad riveting or even improper lightening torque of nuts, excessive use of the drift pin to make holes line up, bad welds, and other practices well known to the construction worker.

c. **Faulty or Failing Foundation:** Even an excellently designed and constructed structure will not stand on a bad foundation. Although the structure will carry its loads, but the earth beneath may not. The living Tower of Pisa is a famous example of bad foundations, but there are many others. The St. Paul, Minnesota, sink to feet or more into soft clay, but did not collapse. The displacements due to bad foundation may alter stress distribution significantly. This was such a problem with railway bridges in America that statically determine trusses were greatly preferred, since they are not subject to this danger.

d. **Extraordinary Loads:** These are often natural such as repeated heavy snowfalls, or the shaking of an earthquake or the winds of a hurricane. A building that is intended to stand for some years should be able to meet these challenges. A flimsy flexible structure may void destruction in an earthquake, while a solid masonry building would be destroyed. Earthquake may cause foundation problems when moist filled land liquefies which can cause building failure.

e. **Unexpected Failure Modes:** These are most complex of the reasons of collapse, and we have recently cited a good example. Any new type of structure is subjected to unexpected failure, until its properties are well understood. Suspension bridges seemed the answer to bridging large gaps. Everything was supported by a strong cable in tension, a reliable and understood member. However, sad experience shared that bridge deck was capable of galloping and twisting without restraint from the supporting cables. Ellet’s Bridge at Wheeling collapsed in the 1840s and
the Tacoma Narrows Bridge in the 1940s form this cause.

f. Incompetence Of Contractors Or Craftsmen: This is a serious issue that can lead to building collapse even before the completion of such structure, if those in charge of the project are not capable or able to do the right thing at the right time on site, it may lead to building failure e.g. improper columns, poor erections, poor settings, poor mixing etc. and as well as lack of professionalism.

g. Unapproved Plan or Self-Help Method: Many property owner and developer deviate from plan approval in order to reduce cost of construction. And by so doing, they may not take the proper design structurally or in a wrong location, and so will not meet the standard of building code and build for their personal satisfactions which may eventually lead to collapse.

h. Corruption and Greed: Many contractors, professionals in building industry and even the government are corrupt and selfish, the contractor will minimise cost to barest minimum by buying substandard materials, so as to keep some money in their personal pocket, even though they have collected their contractor fee for the job. Some Engineers and Architects will emerge in for more contract by this, will not be able to supervise the job properly. Also the unscrupulous government officials that is sent to site to inspect the material that are used are also collecting bribe for their selfish interest and will not see anything wrong on site of interest even when all is not right.

i. Natural Disasters: These are natural phenomenon that occur unawares. Examples are earthquakes, floods, fire hazards, bomb blasts, traditional charm by enemies etc. These natural disasters cannot be stop or prevented since they occur unawares and natural.

j. High Cost of Building Materials: This is a serious issue due to poverty on the part of many developers who want to have shelter at all cost but may not be able to buy the quality material due to the high cost and persistent increase on a day-to-day basis, and by this, they will go for less quality which is harmful and may eventually leads to building failure.

k. Lack of Maintenance: Maintenance culture is deficient in Nigeria. Many property owners build carelessly, they are not concerned about the maintenance of their property, and they hardly maintain the building. This will reduce the lifespan of the property, example are building with crack walls, broken louvers, sagging roofs, roof leakages etc. All these little by little reduces the strength of the building as one faults leads to another (see plate 4).

l. Spiritual Attack: In the Nigerian context, some research also shows that charm and spiritual attack can lead to building collapse, even if the building is free from any structural defect. If there is an existing problem on land issue or people fighting on a piece of land, some may go extra mile by using charm or placing charm on the site of development or while developing the building before completion, it will collapse, and no structural fault will be trace to it.

5.0 EFFECTS OF BUILDING COLLAPSE IN NIGERIA

It can be rightly said that any pursuit of human endeavour has its cost, but the cost being paid in the Nigerian building industry cannot be justified. Each collapse carries along with it tremendous effects that cannot be easily forgotten by any of its victims. The consequences are usually in form of economic and social implications. These includes: loss of human lives, injuries, economic waste in terms of loss of properties, investments, jobs, incomes, loss of trust, dignity and exasperation of crises among the stakeholders and environmental disaster (Ede, 2010).

The quantification of the complete effects of any collapse is extremely difficult as there are so many factors involved, and these including emotional and subjective factors. Apart from the number of deaths that can often be truly identified, the rest of the effects are surrounded by so many uncertainties which make the analysis only approximate. Leaving aside the grossly quantifiable economic sums, the stress, trauma and shocks may have some far-reaching effects upon the building owner and/or employees, occupant, and others involved in one way or the other with the structure. The negative impact of such failures on the social-economic development of our economy is obvious. As many previous lives are lost, the nation loses the contribution that could have come from these victims towards the socio-economic growth of the nation. More so, this increasing rate of death from building collapse in Nigeria runs against the United Nations MDGs (Millennium Development Goals) programmes aimed at reducing the mortality rate and improving safety and life expectancy of the world population. For this, incidence of deaths during the collapse is deeply analysed in the remaining parts of this research work as to proffering solutions towards reducing it.

5.1 BUILDING FAILURE

Failure is an unacceptable difference between expected and observed performance. A failure can be considered as occurring in a component when that component can no longer be relied upon to fulfil its principal functions. Limited deflection in a floor which causes a certain amount of cracking/distortion in partitions could reasonably be considered as defect but not a failure, whereas excessive
deflection resulting in serious damage to partitions, ceilings and floor finishes could be classed as a failure (Roddis, 1993). Those who investigate and report on failures of engineered facilities are in a good position to identify trends leading to structural safety problems and to suggest topic for critical research to mitigate this trend (Chapman, 2000). Frequently, consultants in the office, when they visit sites, see the same mistakes being made time and time again. Many of these are indicators of lack of knowledge on the part of the people undertaking the construction. It is strange to see well-fitted houses that have associated poor construction details that results in large subsequent repair bills.

Unfortunately, many of the explanation given for these poor practices are that they are common trade practices. This leads to repetition to bad practices resulting in construction failure (Philips, 2002). Failure in buildings could be of two types namely; cosmetic failure that occurs when something has been added to or subtracted from the building, thus affecting the structures’ outlook and structural stability of the building.

In Nigeria, building failures have been attributed to the following causes: design faults (50%), faults on construction site (40%) and product failure (10%) (Oyewande, 1992). Hall (1984) ascribed faulty design, faulty execution of work and use of faulty materials as major causes of structural failures. Fredrick and James (1989) suggested that the overturning of structures due to heavy wind loads, sliding of structures due to high wind, roof uplift or sliding, and building sway due to lateral loads are major types of failures of buildings. On the other hand, Akinpelu (2002) categorized the following as major causes of structural failures; environmental changes, natural and manmade hazards, improper presentation and interpretation in the design. Richard (2002) opined that deterioration of reinforced concrete could occur as a result of: corrosion of the reinforcement caused by overloading, subsidence or basic design faults, and construction defects.

Seeley (1993) recognized three major types of maintenance in building in order to restore its defective element to an acceptable standard namely; day-to-day, cyclic, and planned maintenance.

5.2 THE VARIOUS DEFECT IN BUILDING
Defect in building is a common failure occurring on building which no building can do without any particular type of defect. The defect in building without and response can lead to building collapse. Ghafar, 2004 highlighted the following defects in building which are commonly found in building:

- **Fungus Stain and Harmful Growth**
Fungal stain or mud occur when there is moisture content in the walls. It flourishes in an environment of high humidity with lack of ventilation. Harmful growth includes creeping an ivy, plant that can grow either on walls, roof or gutter, this usually happens when dirt penetrates small opening in the walls and mortar joints creating suitable ground for seed to grow. Roots can go deep into the existing holes causing further cracks and water penetration.

- **Erosion of Mortar Joints**
The main function of a mortar joint is to even out the irregularities of individual works either stones or bricks. Causes of mortar joint erosion includes salt crystallisation, scoring actions of winds, the disintegrating effect of wall growing plant; and water penetration resulting in dampness. Decayed mortar can be forcibly remove with a mechanical disc or manually raked out using a knife or spike.

- **Peeling Paint**
Peeling paint usually occurs on building facades, mainly or plastered wall columns and other areas that are exposed to excessive rain and dampness. Some building located near the sea may face a greater risk. The amount of constant wind, rain and sun received can easily turn the surface of the paint to become chalky and unclad or blistered. As is the case in many vantage building, several layers of paints have been applied onto the plastered walls over the decades. Apart from line wash, other types of paints used include emulsion, oil-based, for bituminous and oil-bound water paint. Different types of paints require different methods of removal depending on their nature.

- **Defective Plastered Rendering**
Defective plastered rendering occurs mostly on the external walls, columns and ceiling. In a humid tropical climate, defective rendering are normally caused by biological attacks arising from penetration of rain, evaporation, condensation, air pollution, dehydration and thermal stress. Other causes may be the mould or harmful growth, insects, animals and traffic vibration prior to being decomposed and broken apart, deteriorating may crack due to either shrinkage or movement in the substrate.

- **Cracking of Walls And Leaning Walls**
External walls may be harmful to a building if they are structurally unsound. Vertical or diagonal cracks in the wall are common symptoms of structural instability. Such defects should be investigated promptly and the causes diagnosed; be it the foundations, weak materials and joints; or any shrinkage or thermal movements such as those of timber window frames. Diagonal cracks, usually widest at the foundations and may terminate at the corner of a building, often occurs when shallow foundations are laid on shrinkage subsoil which is drier than normal or when there is a physical uplifting action of a large trees much roots close to the walls. Common causes of leaning walls include a spreading root which forces the weight of the root down towards the walls, sagging due to soil movement, weak foundation due to the presence of dampness, shrinkable clay soil or decayed building materials and
Disturbance or heavy mature trees with roots expanding to the local settlement.

- **Defective Rainwater Goods**

Problems associated with the defective rainwater goods includes sagging or missing caves, gutters, corrodes or broken down pipes, and lacking rainwater reads. Other problems include undersized gutters or down pipes which cause an overflow of water during heavy rain, and improper disposal of water at ground level due to inadequate painting, iron rainwater goods can rust and fracture. Lack of proper wall fixing, particularly by projecting leads ears or hags can cause instability to the down pipes; if routine building inspection and maintenance have been neglected, rainwater goods can be easily exposed to all sorts of defects.

- **Decayed Floorboards**

Widely used in many vantage building including churches, school residences and railway stations, some timber floorboards have been subjected to surface abuse and subsequently deteriorate leading to structural and public safety problems. The main causes are past attacks, careless lifting of weakened boards, by occupied electricians and plumbers, lack of natural preservatives and corroded walls.

- **Insect Or Termite Attacks**

Timber can deteriorate easily if not exposed to water penetration, high moisture content and loading beyond its capacity. Insects or termite attacks pose a threat to damp and digestible timber found in water plates, the feet of rafter, bearing ends of beans and trusses, as well as timber which are placed against or built into damp walling. It is unwise to ignore timber that is lined with insect or termite holes because they may in the time soften the timber and form further cracks. Affected timber can be treated by pressure spraying with insecticide or fumigant insecticidal processes.

- **Roof Defect**

As roof often acts as a weather shield, it is important to treat aging roof tiles. Clay roof tiles have been widely used in the heritage building. Common defects of roof tiles include corrosion of nails that fix the tiles to battens and rafters, the decay of battens, and the cracking of tiles caused by harmful growth. Harmful growth poses a danger to the tiles because it may lift tiles which tend to decay or take off over the years.

- **Dampness Penetration Through Walls**

Dampness penetration through walls can be a serious matter, particularly to buildings located near water sources. Not only does it deteriorate building structures, but also damages on furnishings. The main causes of dampness is water entering a building through different routes. Water penetration occurs commonly through walls exposed to prevailing wet wind or rain. With the existence of gravity, water may penetrate through capillaries or cracks between mortar joints, and bricks or blocks, before building up trap moisture behind the hand renders. Water may also drive further up the wall to emerge at a higher level. Dampness also occurs in wall due to other factors such as leaking gutters or dampness, defective drain, burst plumbing and condensation due to inadequate ventilation. Dampness may also enter a building from the grange through cracks or mortar joints in the foundation walls.

- **Faulty Foundations**

Foundation are critical in distributing from roofs, walls and floors onto the earth below. They are structurally important to the permanence of a building and should not be lacking, it is pointless investing on superficial restoration work. Most of the common problems associated with the foundation depend on the geology of the ground upon which a building stands, structural failures as well as presence and height of a water table. Additionally, inherent failures may also happen in a building in which has to cope and carry any unsettled building structure, which is unsafe to users and occupants. Unstable foundation may occur because of several reasons including shrinking clay soil penetration of dampness and water that may decay walls and foundation; presence of large trees near the building and the undertaking of excavation nearby. They may also occur due to traffic vibrations, deterioration of building materials and the increased loads, particularly with a change in a building function.

- **Poor Installation of Air-Conditioning Units**

Most heritage buildings were built without air-conditioning system. Where people have to content with warm temperatures, the need to install air-conditioning system to meet modern building requirement seems necessary. Subject to the building function, structures and the effects on building fabrics, one should consider several factors before installing air-conditioning units in buildings. The cooler as drier air produced by the air-conditioning system may causes shrinkage of building materials. There may also be a possibility of condensation either on the surface or within the structure the fabric, eventually allowing the build-up of mud. Moreover, it may be difficult installing the air-conditioners as evidences by how units were haphazardly placed on windows or the front facades of some heritage buildings. Such poor practices have greatly affected the appearance of these heritage buildings.

6.0 CAUSES OF BUILDING DEFECT AND REMEDIES

In any building defect, there is a cause of such defect, and as such, does have remedies. Olowoake (2006) asserted that defects are failures occurring on a mortar and they are structural failures in building. Defects are caused either as a result of mistake in design and poor supervision on site.
7.0 THE EFFECTS AND PROBLEMS CAUSED BY BUILDING COLLAPSE

Building collapse has many effect on the economy of nations as a whole (lives and properties) and as a result, the following have been identified as the effect of building collapse;

- **Abrupt Loss Of Lives And Property**

when a building suddenly caves in is in doubt very serious because it is always accompanied to unpreventable loss of innocent lives and their properties as well e.g. the last two occurrence of building collapse happened in Synagogue Church of all Nations belonging to Pastor T.B Joshua in Ikotun area of Lagos State which accounted for the loss of more than 100 lives (majority of who were South African Nationals) and property running into millions of Naira was destroyed. The other most recent one happened in Lekki Phase 1 (a low density residential area) in May, 2016 which claimed more than 5 lives. Collapse of building affect many individual lives that occupy such property at the moment, building collapse occur in such building without any notice, therefore, individuals in the building may lose their lives if there is no quick response/intervention and attention from the people around. Also, it causes high degree of injuries on people like; broken legs, hands, waist etc. and other injuries that may cause permanent disability to the victims.

- **Waste of Properties**

Property worth millions of Naira has been wasted in Nigeria most especially in Lagos due to building collapse. People invest for the purpose of making profit and/or personal uses and when it collapses, it discourage investors for further investment in property. The collapsed property most time cannot be regain except such property has been insured, which most developers hardly do these days.

- **Discouragement of Property Development**

Persistent collapse has discourage many developers to invest in property development, most especially those who are new in the system. As a result of this, they may move into other investments e.g. stock and shares.

- **Scarcity of Property**

Continuous collapse of property may lead to scarcity of property in a particular area as the demand for property may go higher. Also as it discourages investors or property developers, the units of dwelling will also reduce, and this will lead to scarcity of property or short falls.

7.1 PREVENTION AND SOLUTION TO BUILDING COLLAPSE IN NIGERIA

Many authors agreed that building collapse cause a lot of problems in the building industry and have so many effect on the economy of the country. Hence, the need to prevent...
building from collapsing requires serious attention. Stella (2010) stated that the need for a functional Building Code that is enforced against all odds has always been canvassed for at the end of the occurrence. Yet after a while the clamour dies until another one occurs.

However, the Lagos State Habitat 2011 Board is on board and is currently proposing to Lagos State Building Control Agency (LABCA), an agency that will ensure that construction professionals adhere strictly to lay down standard as part of efforts to address the problems and other issue in the state. Therefore, as part of the objectives of the board and National Institute of Architect (NIA) will work together to find some modalities in shaping the new Lagos devoid of quackery to ensure professionalism in the construction industry to preventing these unending collapse of building. Prevention of building collapse should not be limited to the efforts of the government and professionals, but the properties developers also have their vital role to play by building at the right place, the right time, using the right people and the right resources.

Adewunmi (2009) added that building collapse in Nigeria are man-made and not natural; disasters, therefore they are avoidable. Building collapse can be control if all building design are carried out by qualified professional Architect, Engineers etc. and ensuring certified builders are fully involve in the construction of buildings. Considerably, more work will need to be done to encourage (or ensure) that prospective developers are enlightened on the respective roles of foremen, civil engineers, builder and architects. In addition, qualified Town Planners should always inspect and approve building plan appropriately. The federal government through COREN (Council for Regulation of Engineering in Nigeria), CORBON (Council for Regulation of Building in Nigeria) and NSE (Nigerian Society of Engineers) etc. should mandate compulsory Health and Safety by certification for developers and builders. Architects should restrict their activities to preparation of drawing and verification; visits to sites and should not be involve in Jack-of-all-trade by insisting in supervision of building.

There should be mutual respect among professionals. Standard Organisation of Nigeria (SON) should come up with massive sensitization and awareness campaign amongst the professionals in the building industry on the danger in the use of inferior/substandard building materials and mandated that substandard materials are not sold in the market, while their colleagues COREN, CORBON and NSE should come up with a Nigeria Local Code of practice rather than “copy-and-paste” existing foreign base ones that might not be workable in Nigeria. In summary, if the following steps are followed, it will stand as a solution to the problem of building collapse;

• **Frequent Maintenance**

Maintenance culture in Nigeria is lacking in all its ramifications. Even majority of the basic infrastructures in the country are ill-maintained not to talk of the structures. Maintenance should be carried out in building periodically, so as to keep the building in good condition always and enable it to have long life span.

• **Building Plan Approval**

Before any construction work starts, the plan approval should be the first thing so as to know if the building is rightfully designed at the right place, acceptable design and load bearing capacity.

• **Lubrication Soil Test**

This is also very important so as to know the strength of the soil if it can bear load or not and to know the type of foundation to be used because foundation design is the strength of the building.

• **Quality Materials**

Quality materials should always be used, and must be tested before usage. Cost should not be minimized to get a quality and standard material. As it is dangerous to the life of the developers and the property itself, when sub-standard materials are being used.

• **Good Design**

The design must be given to the professional e.g. the Plan drawing to the Architect, while the structural, electrical and mechanical drawing should be done by the Engineers. And the drawing should have good drainage and ventilation openings that is well positioned so as to enable the building to have good strength, durability, stability and to achieve thermal comfort.

• **Involvement of Professionals**

At all level from conception to the delivery stage, professionals of all kinds should be involved in all aspect of the project for perfection, and professional touches and advice. All these is needed to avert any unforeseen circumstances as regards structural failure.

8.0 **RECOMMENDATIONS**

Haven done justice to the issues surrounding the incidence of building collapse in Lagos state, the following were recommended:

1. In order not to put the square peg in the round hole, the building professionals should equip themselves with a detailed geographical and climatic data of their site of interest for a robust consideration for environmental factors especially, the geographical configuration i.e. soil, topography, hydrology, geology etc. and other climatic data of such site.
2. The developers should not be in a hurry and also keep enough funds for development and deal directly with professionals with good track records and credibility instead of quacks.

3. Adequate and proper test should be carried out for property that have reached old age and if defects were numerous, occupants should be advised in their best interest to vacate the building premises.

4. Building professionals should ensure to carry out proper and efficient supervision of works on site as well as thorough inspection of materials to be used for the construction from sub-structure to superstructure.

5. The government and professional team involve in building construction should continually enlighten each other on how to embrace good and quality professional practices as well as enlightening the general public from time to time on the best professional to approach whenever the decision to go into development is made. Also, to warn them that if the right channel is not followed the end result could be disastrous.

6. The professionals such as the Architects, Builders, Engineers, Town Planners, Estate Surveyors and Valuers as Project Manager, Quantity Surveyors, Estimators need to come together periodically to discuss the problems facing the industry and suggest way forward.

7. To save Nigeria from further agony and trauma, building approval should be in phases, design and site of the building should be approved by the concerned ministry and the government agencies should take the task very serious without bribe collection from client.

8. Government should enact a Law that will aim to curbing the use of sub-standard materials and making sure that high quality material prices are subsidised so that all income level can afford it. Hence, if all these recommendations can be taken seriously, it would provide a lasting situation to the menace of collapsed building and the psychological traumas it causes on its victims.

9. The issuance of Certificate of Commencement of construction work should be in place, issuance for stages of construction works base on application by builders in charge on site. Government should also apply strict development control measures to avert any incidence of building collapse.

10. Government should ensure that before any work commence on site, the materials to be used must be stamped by various professionals working on the site.

11. The menace of building collapse is one that requires all stakeholders’ urgent attention. To this end, both government and private individuals make conscientious efforts to make sure that only the approved plans are strictly followed.

12. Government officials in the Housing and Environmental Ministries must constantly inspect construction sites to ensure that only the approved plan are followed without any compromise.

13. Proper supervision and monitoring team should periodically inspect building materials used for construction. This will ensure sub-standard goods are not used for construction.

14. Another way through which this problem can be solved is by engaging the services of a qualified professionals such as; builder, civil engineer and the Estate Surveyor and Valuer for construction and proper supervision of the project.

15. The building professionals should enlighten the populace of the importance of their profession and the need for ordinary man to contact a certified builder for a new development. Also, government institutions in charge of buildings and development should ensure that the building codes are strictly adhere to, especially for a new development.

16. Foundation of building should be taken into consideration before putting load on it i.e. this would determine the number of floors. Approved plan of the building should be strictly adhered to. Avoid using building that is meant for Residential use as Commercial. As we understand that Residential building cannot withstand intensive use and human traffic.

9.0 CONCLUSION
Building development in all its ramification is more than shelter. It entails processes evolve in stages. The stages involved include; the planning, designing, costing, and execution of the project by professional in accordance with the legal provision, bye-laws, standards and specifications.

The aim of every developer is to develop properties and enjoy the investment whether through personal use or by generating income from it, and not to claim the lives of loved ones and properties. This paper has shown that building collapse have very high effect on human lives and property and as a result of personal greed of many developers, corrupt government agencies on site and professionals who are contractors and project managers in the building industry are adding more to
the problems. Most property developers patronise quacks due to lack of funds for development and are desperate to have shelter; the government agencies collect bribe and are unable to do the thorough supervision of plan approval and project, the contractors and project managers failed to use quality materials for building projects.

These are becoming the habits in Lagos. People loses their lives and properties very often in various crannies of Lagos and Nigeria at large due to some peoples’ negligence, corruption and greediness. The incidents of building collapse therefore calls for the sites works and also to investigate the quality of materials, craftsmen and the nature of contractors involve in the construction on sites. This will justify the need to carryout research work on building collapse in Lagos with a view of examining its design and construction problem.

Therefore, recommendations highlighted above should be taken with serious attention, as it would provide a lasting solution to the problems of design and construction of building which may results to building collapse in Lagos and Nigeria at large.

REFERENCE


[31] Saturday Punch 9th July, 2011: Controversy Over Death Toll At Idamota Building Collapse by Adedamola Olotun

