

MEASURES TO REDUCE THE HIGH INCIDENCE OF STRUCTURAL FAILURES IN NIGERIA

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ABSTRACT

Within the last few decades, Nigeria has been experiencing a great transformation in terms of population growth and the provisions of developmental facilities for the wellbeing of the masses. The built environmental sector was not left out in the process. This is because the construction of houses and infrastructures are essential to man next as air, water, and food (Salau, 1996). These structures served as residences, places of work, worship, entertainment, as means of transportation, etc. As the population and economic activities continued to explode, the demand became more pressing. This justified the massive housing and infrastructural development that has been going on in the urban and rural areas of the country in the recent times. But an embarrassing feature of our building and infrastructural developmental strive is the failure rate verified among the existing structures and those under construction. The cost of these collapses, in terms of human life and economic waste, cannot be over emphasized. As the effect of the global warming began to take its toll in many parts of the world, including Nigeria, the need to arrest this ugly situation in our built environment becomes very expedient (Ede, 2010). In light of these issues, this paper analyses the problems of structural integrity in Nigeria as the environmental setup worsens and proffers measures bordering on the improved professionalism and craftsmanship that will reduce the menace drastically.

Keywords: Built Environment; Structural Failures; Global Climate Change; Millennium Developmental Goals (MDGs); Sustainable Development

INTRODUCTION

For the past five decades, Nigeria as an independent nation has been striving to develop itself in every field of human endeavour, obstacles notwithstanding. Currently, Nigeria is pursuing the "Vision 20-2020" as one of its strategies to become one of the top leading 20 economies by the year 2020. In order to realize this vision, the nation has been advised by the Accenture, the official consultant on the vision, to focus on the development of five key sectors of talent, capital, resources, consumers, and innovations. This entailed that the nation must equally embark on a massive housing and infrastructural development. On the other hand, the built environment, in any country, determines the nature and pace of national development and the citizens' quality of life. It has a major influence on the progress towards the attainment of the Millennium Developmental Goals (MDGs), which were aimed at reducing poverty worldwide (Ofori, 2010). The construction of buildings and infrastructure are vital inputs for economic activity, leading to economic growth and increased incomes in the short run, and national development in the long run. The provisions of school buildings, health facilities, as well as the houses that meet the slum improvement objective in the Millennium Declaration, are all directly from the construction industry. The construction activity extensively stimulates growth in other sectors of the economy and provides direct employment opportunities for the populace. Considering the importance of the sector to Nigerian

economy and as the quest to achieve sustainable development continues, the construction industry requires adequate attention from all the stakeholders. On the other hand, the failure rate of the existing structures and the ones under construction appeared not to be encouraging and must be addressed.

The purpose of all construction work is to create a structural system that meets some needs. For this, a structure must be designed to avoid failure, which may result in the loss of life, property, waste of resources or damage to the environment. Not minding all the efforts being made by the stakeholders to avoid failures, structures failed over time as a result of design flaws, aging, material fatigue, negligence, accidents, terrorist attacks, extreme operational and environmental conditions, and natural hazards, such as floods, lightening, hurricanes, and earthquakes. Apart from these known causes of structural failures, we can add the effects of global climate change, caused by the depleting ozone layer, as future causes of structural failures. Global warming is a reality that has come to stay with us, as it has been confirmed by numerous researches round the world (Rudrappan, 2010). This means we must save our planet.

As the effects of the climate change are being made manifest around the world, it is now known to us that no nation, including Nigeria, is immune from it. It is a known fact that climate change increases the rate and intensity of extreme weather events and those effects are already evident across the length and breadth of Nigeria. They include, but are not limited to, desert encroachment in the northern part of Nigeria, many rivers drying up, gully erosion in the south eastern part of the country, rising sea levels, and flooding in various parts of the of the coastal areas of the country. About half of the residents of Lagos, in the low lying coastal areas of Southern Nigeria are particularly under threats of flooding during the six months of raining season every year. All these effects of climate change will lead to damages to the few existing infrastructures, threats to health due to rising temperatures, and different forms of social dislocation. As the cases of structural failures are now very frequent in Nigeria and continue to be a permanent feature in Lagos and elsewhere in the country, we must halt this preventable catastrophe that is causing loss of lives and environmental disasters. Although this research is focused on buildings, the failures referred to are common to the roads, drainage systems, dams, and buildings.

LITERATURE REVIEW

In the past 30 years, collapse of buildings has been on the increase in most Nigeria cities, especially within the Nigerian coastline. A lot has been written in the academic journals and in newspapers about this national embarrassment, but the situation does not seem to be abating either because the true causes are not yet identified or because those in charge have not taken the appropriate actions to put the situation under control. Salau (1996) highlighted the first cases of building collapse verified in Nigeria, their possible causes and suggested among other things the involvement of qualified engineers in the different phases of building construction process and the review of academic programs to enhance the capacity of craftsmen and technologists in the building industry. Olajumoke et.al., (2009) assessed the causes and socioeconomic impact of some recent causes of collapsed buildings in Nigeria. They concluded that the construction industry requires oversight and committed engineers. Ayininuola and Olalusi (2004) focused on the causes and possible solutions to building failures in Nigeria. The summary of their research was that the presence of unqualified professionals was the principle cause of building collapse and they therefore called on the professional bodies to step up their surveillance of the building sector as to eject the imposters. Adeniregun, (2010) reviewed all the available data on building collapse in Nigeria over the past three decades. The research came up with the most complete list of collapsed buildings in Nigeria in the recent years (56 cases) with information on the date of occurrence, type of buildings,

addresses, casualties and possible causes. Though some of the information provided was fragmentary, the available facts hold the most comprehensive information on issues of building collapse in Nigeria. These facts provide valuable information to for future projects and forms the base for broader research works on collapse of buildings both in Nigeria in other developing countries. I supervised the collation of these data and it formed the basis for this present research.

GENESIS OF STRUCTURAL FAILURES IN NIGERIA

From the historical data collected for this research, it was verified that the incidence of collapse has been on the increase from 1985 till date. Various papers have been written on this phenomenon, from Salau (1996) to Adeniregun (2010), all high-lighting some of the causes and the possible solutions. Though much have been said about the frequent collapses in Nigeria, there are still rooms for further research as the phenomenon does not show sign of abating. It is either the true causes of collapses are not yet identified or that the stakeholders deliberately refused to do the right thing. This research therefore is focused on produce strong measures capable of bringing these structural failures under control.

Before proposing the measures that will drastically reduce the frequency of building collapse in Nigeria, I will highlight the basis for obtaining robust structures that resist test of time in contrast to what is obtainable in the Nigeria built environment.

What is Expected for the Realization of Robust Structures

The purpose for any structure of a building is to satisfy some human needs. The design of any such structure must satisfy the functional objectives of safety, serviceability, and economy. The tools to enable the engineer to realize these objectives are his knowledge of structural mechanics, available research materials, government regulations, codes, his experience, and professional knowledge. The structure must be safe under the worst system of loads. Under extreme loadings, damage to the structure can be localized and possible loss of lives reduced, but progressive and catastrophic collapses must not occur. Under the working load, the deformation of the structure must not impair the appearance, durability, and performance of the structure.

A structure is assumed to have failed when it can no longer serve the purpose for which it was built. Failures may occur during construction or later in the course of the design life of the structure. Irrespective of the type of failure or the period in the lifetime of the structure that the failure occurs, the effects are always devastating.

The possible causes of failure can be traced to the activities that take place in the following stages of a building process: conception-design stage, construction-supervision stage, and post construction-service stage. For the realization of quality jobs in any of these stages of the building process, a high level of skill and professionalism is needed (Ayininuola & Olalusi, 2004).

The conception-design stage is the planning and feasibility studies stage in which some professionals may assist the owner to evaluate the technical and economical options available and then realize the design. The design consists of the creation of the architectural form, identification of the loads, selection of materials, and proportioning of the sections. During this stage, the basic requirements of safety, aesthetic, economy, and constructability must be considered, irrespective of the client's brief (Davison & Owens, 2003). The structure produced from this design is strictly for the

loads considered. Should there be need to subject the structure to loads greater than the design loads, it will be essential for a certified engineer to redesign the structure for the new loads and make adequate strengthening on the structure where necessary.

The construction stage is the physical realization and over-seeing of the structure designed in the previous stage. During this implementation stage, every effort is made to ensure compliance with the design and specifications. The activities that take place within this stage are so numerous, and often conflicting with each other. The management of scheduling, materials, human and technical resources is often enormous such that only trained professionals can handle them. Certified engineers, architects, builders, and skilled artisans all have their respective roles in this phase so as to enforce the quality assurance specifications.

During the service stage, the constructed facility serves the purpose for which it was built. It is expected to serve effectively the purpose for which it was built without causing any form of discomfort to the user. For a good usage of any built structures, a management and monitoring team must always be at hand to continuously assess the true state of the structure and make recommendations for maintenance. Visual inspection may be combined with Non-Destructive Testing techniques to assess internal defects and make maintenance meaningful (Ede, 2008). Failure to execute appropriate maintenance may pose a great danger to the structure and the users.

What is obtainable in the Nigerian Built Environment

Structural failures occur all over the world. The rate of occurrence and the intensity of damage are low in the advanced nations where strict controls, enforcement of the codes and high ethics of professionalism are obtainable. Even under severe natural hazards such as earthquakes, catastrophic destructions are often curtailed because of the ductility inherent in the structures. For example, the extensive collapse and casualties verified in the recent earthquake in Haiti is related to the absence of ductility in most of their buildings, including the presidential palace. Recent earthquake in Italy of comparable magnitude produced far less damages when compared to the Haitian seismic event.

In Nigeria, many structural failures have occurred within the recent years, practically in all areas of built environment. As I was finishing this paper, on the 14th of March 2011, a five-storey building for hotel under construction collapsed at Adenubi Close, Ikeja, Lagos State. On a regular basis, just a one-day non-stop rain fall is enough to hold the whole Lagos State to a standstill as failed drainages and flooded-potholed roads make it impossible for most people to go about their activities. Of the 65 cases of building collapse around Lagos and its environs that were considered in this research, a total of 384 human casualties were reported while the number of injured were numerous.

One of the most pathetic issues concerning these collapses is that not all the cases are brought to the knowledge of the public. When they occur in remote areas or in exclusive private environments, the news is not made public. Another issue is the quality of information that comes from the journalists after each collapse. Since most of them have no technical idea of structures, they release news that is not compatible with the causes of the collapse. Without any idea of building technicalities, passersby pronounce the causes of the collapse. Conclusions are made before any serious investigation takes place. Only accurate forensic analysis is needed to ascertain the true cause of most structural collapses.

The causes of these failures in the Nigerian built environment can be traced to abnormal factors not obtainable in most nations. Worldwide, the generally known causes of structural collapse are design flaws, ageing, material fatigue, extreme operational and environmental conditions, accidents, terrorist attacks, and natural hazards. But in Nigeria, the principal causes of collapse are non-adherence to the building codes, use of unskilled artisans, poor supervision, inferior materials, ignorance, lack of maintenance, misuse of structures, conflicts among professionals and corruption. As the world economic meltdown continues to bite harder in most parts of the world, the spill-over effect continues to threaten various areas of our lives including the construction industry.

METHODOLOGY

Historical data on building collapses which occurred in the last 3 decades were analyzed to identify the trend and the common features of structural collapses in Nigeria. Data on behaviour of the professionals and the craftsmen were also analyzed to identify how they operate in the sector and how their actions contribute positively or negatively to the collapses.

ANALYSIS OF DATA, RESULTS AND DISCUSSION

From the historical data collected for this research, it was verified that the incidence of collapse has been on the increase from 1985 till date. Absence of standardized training programs for the craftsmen in the building industry was found to be one of the fundamental causes of defects in our structures which often culminate to collapse. The information that was obtained during this research showed that over 80% of the artisans never had certified technical training on the jobs they perform at the sites.

In fact, the Government trade centres that use to be the pride of the nation in producing craftsmen eventually lost their glory as not much attention is paid to them. For this, the building industry is populated by unskilled artisans, who have no technical idea of the works they are often called to do. There is no enforced training or certification for the artisans.

Next to lack of training for the artisans is the generalized ignorance in regards to many of the operators in the sector. There is hardly a building in Nigeria, whether private or public, without visible defects which are condoned by the clients: if it is not structural, it will be electrical, plumbing, or stone finishing. Then as the ignorance factor intermixes with corruption, the situation gets out of control. Unless a client is very knowledgeable of the quality of product he wants and endeavour to enforce it, he will end up paying for the highest quality and obtaining the least. A much diffused example is the case of steel reinforcement, where 11.5mm diameter rods are easily traded for 12mm diameter. This translates to a loss of 8% area of steel for every single rod adopted. Manipulations like this sum up to make Nigerian constructions very expensive. This culture of not paying attention to defects goes on to define the maintenance culture: many building proprietors hardly know the right time to maintain the structures until collapse occur.

Next to be considered are the anomalies verified on the analysis of data on the professionals (practicing architects, structural engineers, builders, town planners, and contractors) involved in the Nigerian building industry. The town planners, some of the architects and the engineers considered in this paper worked in the public establishment.



Figure 1: Percentage of professionals registered with the professional bodies [Data from Adeniregun, 2010].

The issues considered were the certifications of the professionals involved in the Nigerian building industry, how they make request for approvals before site works begins and whether or not they perform material test for projects they handle. Twenty five professionals from each group were considered in the research work.

Figure 1 shows the information on practicing professionals that are registered with their professional bodies. Figure 2 presents the proportion of professionals that seek approval before commencement of work at site. Figure 3 showed the proportion of professionals that insist on material test before the commencement of projects. From the historical data considered, information on the relationship between the heights of the building and rate of collapse can be seen in figure 4. Based on this figure, it can be deduced that as the complexity in the building process/height increases (above 5 storey buildings), incidence of failure decreases. This can be attributed to the fact that the most common types of buildings realized are of lower heights. For higher heights, the unskilled are forced out of the process as more reputable firms (often foreign firms) are brought into the process. These leads to the fact that part of the causes are related to massive presence of unskilled labour and quacks in the field.

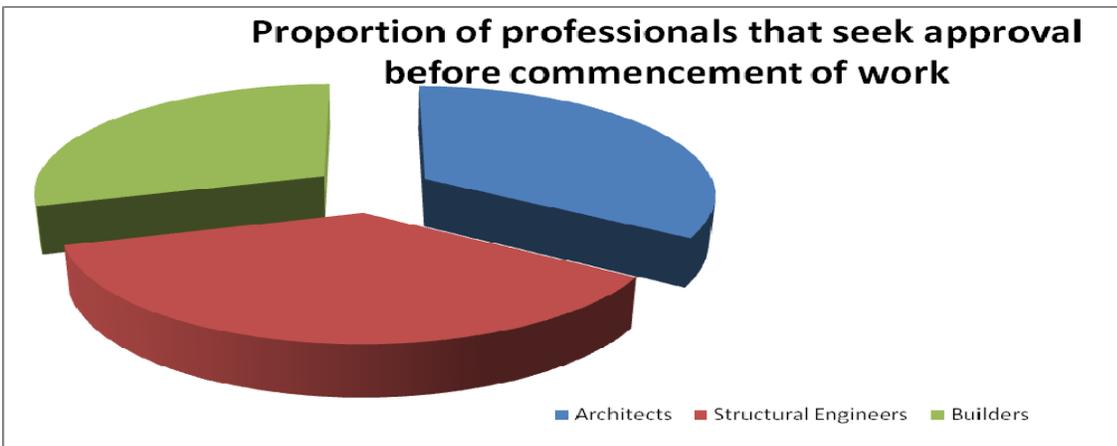


Figure 2: proportion of professionals that seek approval before the commencement of work [Data from Adeniregun, 2010]

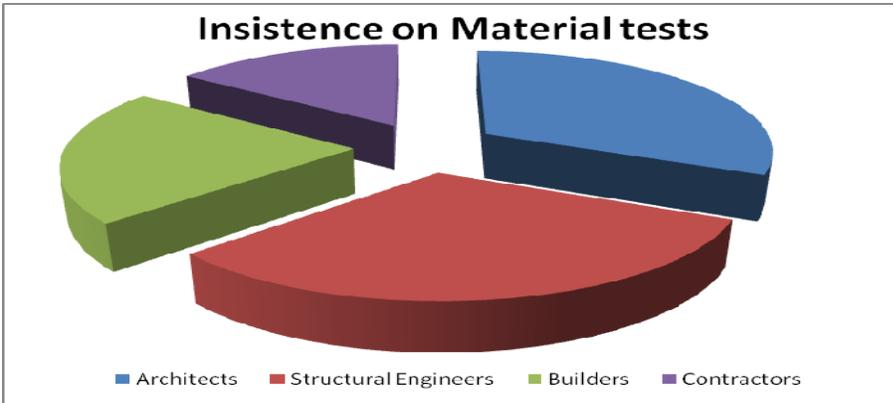


Figure 3: proportion of professionals that insist on material test [Data from Adeniregun, 2010]

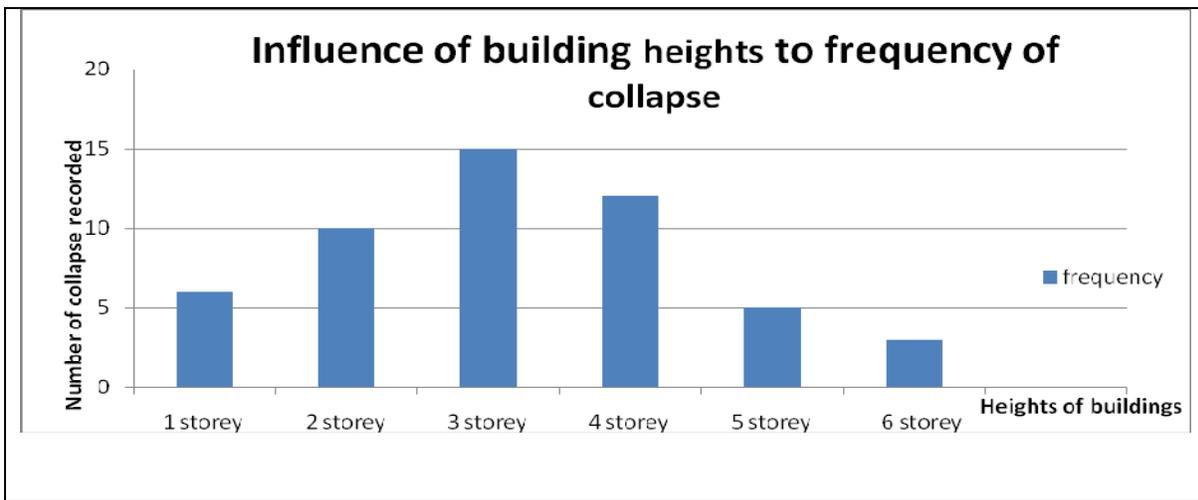


Figure 4: Variation of collapse with respect to the heights of the building [Data from Ede, 2010]

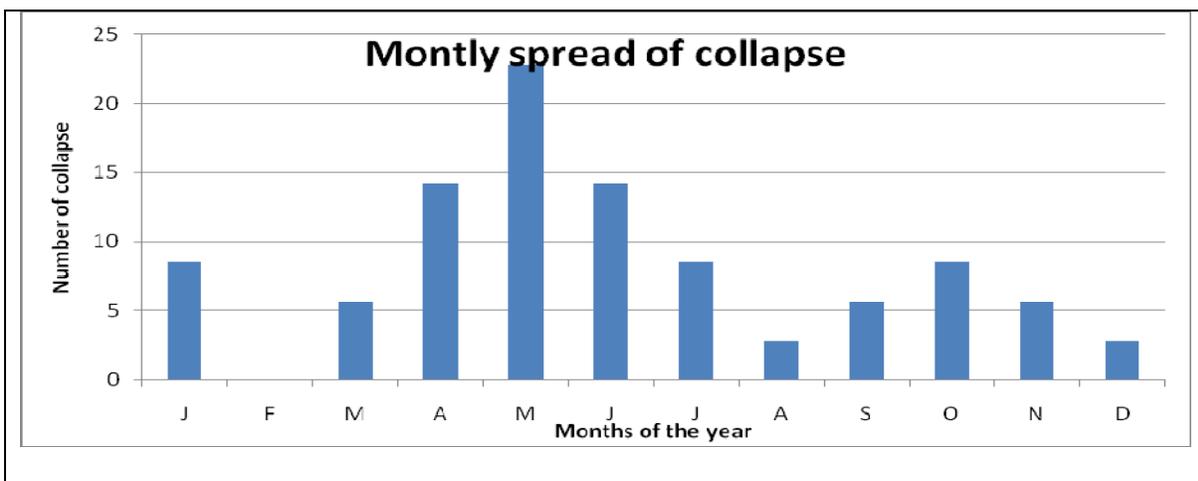


Figure 5: Period of collapse, frequency and casualty [Data from Ede, 2010]

Figure 5 showed the monthly spread of the collapses in a year. From this monthly spread, it can be said that the period between months from March and July is the most dangerous. This period coincides with the peak of rainy season in Nigeria. It becomes apparent that majority of the causes of the collapses are water related problems alone or combined with other factors linked to professionalism of the operators in the sector.

Now, it is a well known fact that the global climate change increases the rate and the intensity of extreme weather events and that a country like Nigeria will not be left out by the damages that accompany it. These climate-related effects will be very severe in the country's 853 kilometres coastline as was evidenced in the rising sea level and flooding in various parts of the coastal areas of the country in the recent years. As all these scenarios present themselves, we should expect a deterioration of the issues of building collapse in Nigeria unless adequate steps are taken to halt the trend.

RECOMMENDATIONS AND CONCLUSION

Based on the aforementioned verifications, the following recommendations are made:

Various governments, professional bodies, and all stake holders gear up efforts towards offering free basic quality trainings to the artisans and at the same time enforcing certification for all artisans involved in the sector. This might imply that at least a trade centre to be established in each of the 774 local governments of the nation as to make them available to all that might need them. The benefit of this scheme is that with the help of skilled artisans, the very frequent cases of collapses during construction or brand new defective structures will be highly reduced. As these artisans will be knowledgeable of the common materials and some basic building technicalities, they will be in the position to identify dangerous errors on time as to bring about correction before it is too late. After all, the very many existing old structures of over 1,000 years old in Europe were built by skilled artisans. In Nigeria most of the collapsed buildings are recent constructions or those still under construction. The older ones collapse for lack of maintenance.

All the professionals involved in the Nigerian building process intensify efforts towards affiliating and upgrading themselves technically through their respective professional bodies. The professionals must operate within their area of competence. The Governments and the professional bodies should make efforts to identify and persecute the unregistered professionals and impostors operating in the various fields. This is because if the trained professionals operate illegally (without licence) in the different fields of construction process, then they are inviting quacks into the profession and that will aggravate the already delicate situation.

That all external construction activities are drastically reduced during the peak of rainy season (April to July) and that more drastic precautions and control be put in place during this period of frequent collapse.

The application of these measures in the Nigeria building industry will enable us to start doing things right and be ready confront the unpredictable weather deterioration emanating from the global climate change. This will also make our pursuit of Vision 20-2020 and MGDs meaningful. If the current rate of collapse can be brought under control, then the drive for sustainable development will start yielding results and will place the nation in a better condition to reduce poverty, achieve the MDGs, Vision 20-2020 and be able to confront any form of emergency within the built

environment. The improvement of our built environment will go a long way in putting Nigeria as a nation and the whole of Africa on the path to sustainable development.

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