

Building Collapse in Nigeria: the Trend of Casualties the Last Decade (2000 -2010)

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Abstract-- Over the last 10 years, the incidence of building collapse in Nigeria has become so alarming and does not show any sign of abating. Each collapse carries along with it tremendous effects that cannot be easily forgotten by any of its victim. These include loss of human lives, economic wastage in terms of loss of properties, jobs, incomes, loss of trust, dignity and exasperation of crises among the stake holders and environmental disaster. It can be rightly said that any pursuit of human endeavor has its cost, but the cost being paid in the Nigerian building industry cannot be justified. The fact that Nigeria is undergoing a tremendous transformation in the built environment cannot be over emphasized. This is in line with the growth that is being experience in the infrastructural and building industries all over the world for the effects of technological breakthroughs and consequently the ICT flattened world.

But experiencing negative trends in the Nigerian building industries while other parts of the world are experiencing total improvements brings to fore the need to come out boldly and confront this ugly situation. The world today is facing a lot of other more serious man-made and natural crises such as global climate change which requires greater preparedness than the level on which we are standing today. For these facts, this paper addresses the impacts of building collapse on Nigerian strive for sustainable developmental. Probabilistic model of the linear regression analysis was used to establish the trend of heights and casualties. The results of this research will go a long way in reducing the building collapse phenomenon and the implications on the efforts of the nation to achieve the Millennium Developmental Goals (MDGs) and the Vision 20-2020.

Index Term-- Building Collapse, High death rate, MDGs, Vision 20-2020, Sustainable Development.

I. INTRODUCTION

For the past 50 years, Nigeria has been striving to develop itself as a nation in every field of human endeavour including the built environment. These structures serve as place of residence, work, worship, etc or as means of transportation. They are so essential to man just as air, water and food (Salau, 1996). The exponential population growth and the consequent productive activities needed to sustain mankind forces the demand to be more pressing. The quest to meet up with this demand has led to different approaches of realizing the housing and infrastructural development – some genuine and some fake approaches, which lead to structures of different qualities. When the quality of these structures fall below certain standards, structural failures are inevitable. In the recent years, a lot of failures are being experienced among the existing structures and those under construction. The failure rate has become so rampant that we have virtually lost count of the number of these disasters.

On the 28th of April 2010, a two-storey market plaza in Oshodi - Lagos, collapsed, killing at least four persons and leaving many others wounded. In the same way another one occurred at Ikole Street, Abuja on 11th of August 2010, killing more than 13 occupants. The cost of these failures in terms of human lives and enormous economic waste, loss of investments, job, income, etc., cannot be over emphasized. Both the environmental impact and the disgrace it brings to the professionals involved in the building industry must not be overlooked also.

Every structural system is designed to meet some needs and be safe to avoid loss of life, property and damage to the environment. In a normal set up, failures are not expected within the projected lifespan of structures. But due to the imperfection in the actions of human beings and the existence of so many other external factors that influence the safety of structures, failures do occur (Ede, 2010). Generally, structures do fail over time as a result of human factors such as negligence, design flaws, ageing, material fatigue, extreme operational and environmental conditions, accidents, terrorist attacks and natural hazards.

But the causes of building collapse in Nigeria can be traced to abnormal factors not obtainable in many other nations. The Lagos State Government identified the principle causes of collapse within the Lagos area as: deficient foundations, inadequate steel reinforcement, poor materials and workmanship and inexperienced professionals, hasty construction, no soil test, greed, poor supervision and non-adherence to the building codes. The causes of collapse in Nigeria identified in literature can be re-grouped as: non-adherence to the building codes and lack of adequate information on applicable code, use of unskilled labour, poor supervision, poor material, flooding, ignorance, lack of maintenance, overloading, conflicts among professionals and tendency of some professionals to step into some lucrative technical fields without the appropriate skill, corruption and tendency to cheat.

As these negative facts occur in the Nigerian built environment, new emergencies continue to emerge in the world. Today, the world is facing a lot of other more serious man-made and natural crises than the type being faced in the Nigerian built environments. One of the principal challenges confronting the world today is the global climate change caused by the depleting ozone layer. Our coexistence with this phenomenon is a reality as virtually most of the world crises and emergencies are linked to that. Our ecosystem is not adapting naturally to the stresses caused by excessive population growth and the consequent increase in human activities (Rudrappan, 2010). 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 its effects.

The climate change increases the rate and intensity of extreme weather events and the effects are already evident across the length and breadth of Nigeria. They include but 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 level and flooding in various parts of the of the coastal areas of the country. Within the Gulf of Benin in which Nigerian coastal boundaries lies in, it has been estimated that the 50-year mean sea level rise is about 3 mm/year, which will translate to about 50 m coastline retreat in the next 50 years. The people living in the low lying coastal areas of Southern Nigeria, particularly in Lagos are under threat. About half of the population of Lagosians living mainly in slums are exposed to this danger. All these will lead to damages to the few existing infrastructures and threats to the safety and health of the populace. For these amazing facts, efforts need to be made to drastically reduce the common incidence of building and infrastructural failures and the high casualty as to be able to face unpredictable challenges that might emerge from the climate change.

It is on these issues that this paper addresses the conceptual issues of building process, analyzes questions raised in field researches on causes and effects of building collapse in Nigeria and suggests ways to bring them under control with the primary aim of departing from inefficiencies and reducing the waste of human lives.

II. METHODOLOGY

This research is based on the analysis of historical data on building collapse in Nigeria in the last 3 decades and on field observations. The research started with the analysis of the basis for the realization of robust structures that live up to expectations, then followed by what is obtainable in the Nigeria built environment and the measures to bring the failures under control. Simple linear regression analysis (Montgomery et.al., 2001) was used for the analysis of the data as to hypothesize a probabilistic relationship between the rate of casualties and the height of the collapsed buildings. In order to further test the extent of linear relationship between the rate casualties resulting from collapse and the heights of collapsed buildings, Pearson product moment correlation coefficient was calculated based on the formula:

$$r = \frac{\sum(x-\bar{x})(y-\bar{y})}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}}$$

where \bar{x} and \bar{y} are the sample means for heights and casualties respectively.

III. THE BASIS OF OBTAINING ROBUST STRUCTURES

Every built structure is expected to satisfy the functional objectives of safety, serviceability and economy. The processes of construction are complex and require the services of trained professionals. A high level of skill is needed both in designing and construction (Ayininuola and Olalusi, 2004). The tools to enable the professionals to

realize these objectives are their professional knowledge and experiences in the different specialized fields involved in the process, available research materials, government regulations and codes. Activities necessary for the realization of efficient structures take place in the following fundamental stages: conceptual and design stage, construction-supervision stage and post construction/service stage. Every part of these stages is extremely important in the life of the structure as a mistake in any stage can have a far reaching effect in the whole building process.

The conception phase is the planning and feasibility studies stage in which some professionals (e.g. Architects, Engineers, Project managers, etc) may assist the owner to evaluate the technical options available for the realization and advice on the feasible choice.

The design phase involves more of technical preparations of the project, where the architect designs the aesthetic form of the structure while engineers design the structural frames, proportion the sizes and choose the materials compatible with the form and the environment. The basic requirements of safety, aesthetic, economy and constructability must be put into consideration during the design process (Davison and Owens, 2003).

The activities of this stage will be completed with the estimation of the resources needed for the execution and the approval by the authorizing agency of the government.

The construction-supervision stage involves numerous and often conflicting activities, such that only trained professionals can handle them. This is the physical construction and over-seeing of the structure designed in the previous stage and every effort is made to ensure compliance of the quality with design and specification. At the completion of the construction work, a certificate of fitness for use is issued to the client to authorize the usage of the structure.

The post construction-service stage is the stage in which the facility serves the purpose for which it was built without cursing any form of discomfort to the user. The usage must be in conformity with the purpose of its design and any variation of usage must be authorized by the competent professionals. The structure must be continually maintained in a good state as to perform its functions for which it was built.

IV. WHY BUILDINGS ARE COLLAPSING IN NIGERIA

Structural collapse occurs all over the world, but the rate of occurrence in Nigeria is beyond bound. The causes of building collapse in Nigeria can be traced to abnormal factors not obtainable in many other developing nations. Apart from the generally known causes of collapse such as design flaws, ageing, material fatigue, extreme operational and environmental conditions, accidents, terrorist attacks and natural hazards, the Nigerian factor becomes a prominent issue to contend with (Ede, 2010). The Nigerian factor in the building industry rears up its ugly head in different forms such as corruption, lawlessness and our presumptions that any engineer or professional in the built environment can assume all forms responsibility in a building process without the basic skill required for it. Corruption is made manifest in greed and tendency to cheat

in virtually every aspect, starting from poor materials and quality of work to the quantities we adopt. As disobedience to civil laws is common in Nigeria, the case in the building industry cannot be different. For this, lawlessness finds a fertile ground in our non-adherence to the building codes and hasty construction. The use of unskilled labour, inexperienced professionals, tendency of some professionals to cross-carpet to lucrative specialist duties where they lack the skill, ignorance and the abundance of quacks in the building industry are all facts to contend with. Excessive rain falls and poor drainage systems pose a serious problem to structures along the Nigerian coastlines. It is a common sight to see sinking old building around Lagos and within the coastal areas due to water related problems and deficient foundations, yet not all the stake holders pay adequate attention to this problem as many new structures manifest the same problem while the structures are still under construction. In fact, most of the collapses verified in the recent years occurred during construction stage. Issues of unregistered engineers and other professionals operating in the field are very rampant. Even people without formal training in any of the trades needed in the construction industry often sneak themselves into the system to perform important tasks. In 2006, the Council for the Regulation of Engineering in Nigeria (COREN) recommended the

persecution of a pharmacist who supervised a collapsed building in Port Harcourt in 2005 (Olajumoke et. al., 2009). If these issues are put under control, then the adverse effects to which our citizens are subjected to will be drastically reduced and we will have more time and resources available to confront other problems and the unpredictable consequences of the global warming which has come to stay with us.

Most of the facts high-lightened above were confirmed by one of the most recent collapse verified in Abuja. On the 11th of August 2010, thirteen people died in a building, which collapsed at Ikole Street, Abuja (figure 1), while about 35 persons are believed to be trapped in the debris while 10 persons were rescued (Bukola, A. 2010). This was the third collapse case in the city since the beginning of the year. The three storey building, a hotel, has been under construction since 2001 and was later marked for demolition by the Federal Capital Development Authority (FCDA) because the owner added an extra floor thereby making it a four-storey building as against the specified three-storey building. When the agency discovered this, the developer was issued a "stop work" order on the 12th of December 2009.



Fig. 1. Catastrophic collapse at Ikole Street, Abuja of 11th August 2010 (courtesy TheNationonline)

The agency enforced the mechanical removal of the additional floor and subjected the entire structure to Schmidt Hammer and Structural Integrity Tests on the 29th July 2010 and the structure failed the tests. All the occupants were asked to move out of the building while legal backing for the demolition was sought but never obtained till the collapse. As some people illegally made the uncompleted structure their sleeping place at night, they became the victims of the collapse. The causes of the deaths verified in

this collapse include among other things greed (the owner had the courage to seek redress from court against the demolition), non compliance with building rules and regulations, disturbance of the structural equilibrium during the removal of the illegal fourth floor, exposure of construction materials to deterioration (due to the infiltration of water and steel corrosion over the past 9 years in which the structure was under construction) low quality materials, use of quacks and unskilled personal, disobedience and

poverty. Despite all the forewarnings and the efforts made by the agency, many deaths still occurred in the building.

V. EFFECTS OF BUILDING COLLAPSE IN NIGERIA

It can be rightly said that any pursuit of human endeavor 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 the form of economic and social implications. These include 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 stake holders and environmental disaster.

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, occupants, 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 precious 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 programs aimed at reducing the mortality rate and improving safety and life expectancy of the world population. For this, the incidence of deaths during the collapses is deeply analyzed in the remaining parts of this paper as to proffer solutions towards reducing it.

VI. ANALYSIS OF DATA AND THE RESULT

In the last 10 years, the high rate of building collapse in Nigeria and the consequent high rate of deaths have been so embarrassing. Many papers have been written on the building collapse issues in Nigeria without adequate analysis of the death rate involved in the collapses. Several reported cases of collapse were evaluated in this work as to verify the trend of collapses and the corresponding deaths. Of the 47 cases of building collapses verified between 2000 and 2010 which I considered in this research (Adeniregun, 2010; Ede 2010), over 300 deaths were verified. Probabilistic analysis where performed to establish the trend of casualties with respect to the heights in the last decade. Analyzing the data for Lagos, Abuja and Port Harcourt which are the three major areas with high rate of casualties, the relationship between the number of collapsed buildings cases and the rate of casualties is shown in figure 2. From here it can be seen that Lagos State humbled the rest of the nation on issues of building collapse and casualties.

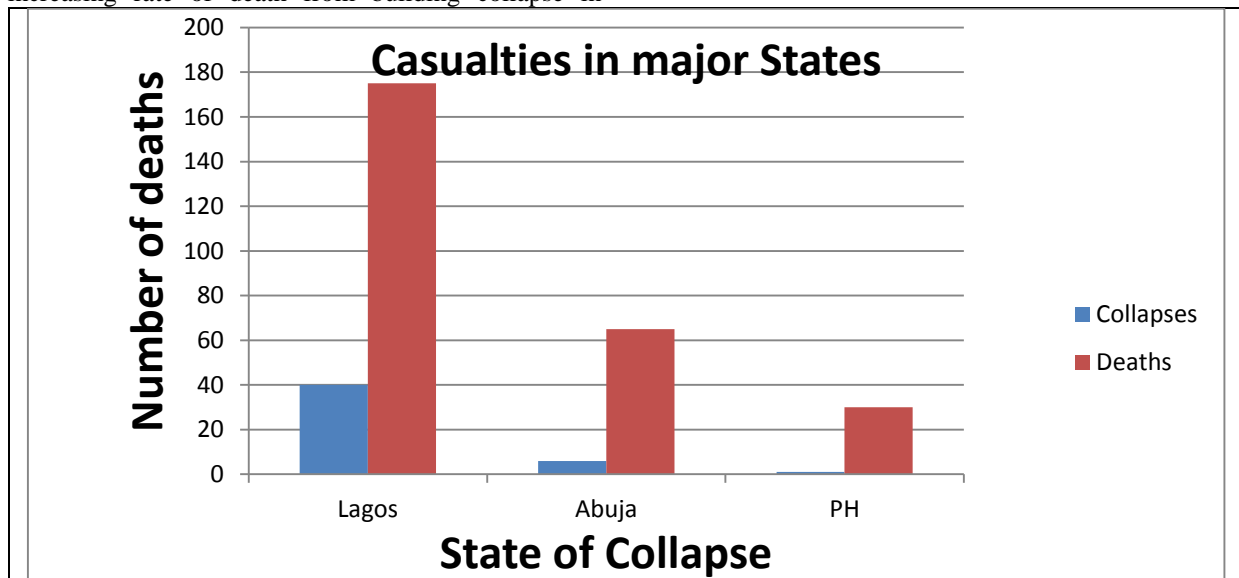


Fig. 2. Casualties verified in Lagos, Abuja and Port Harcourt

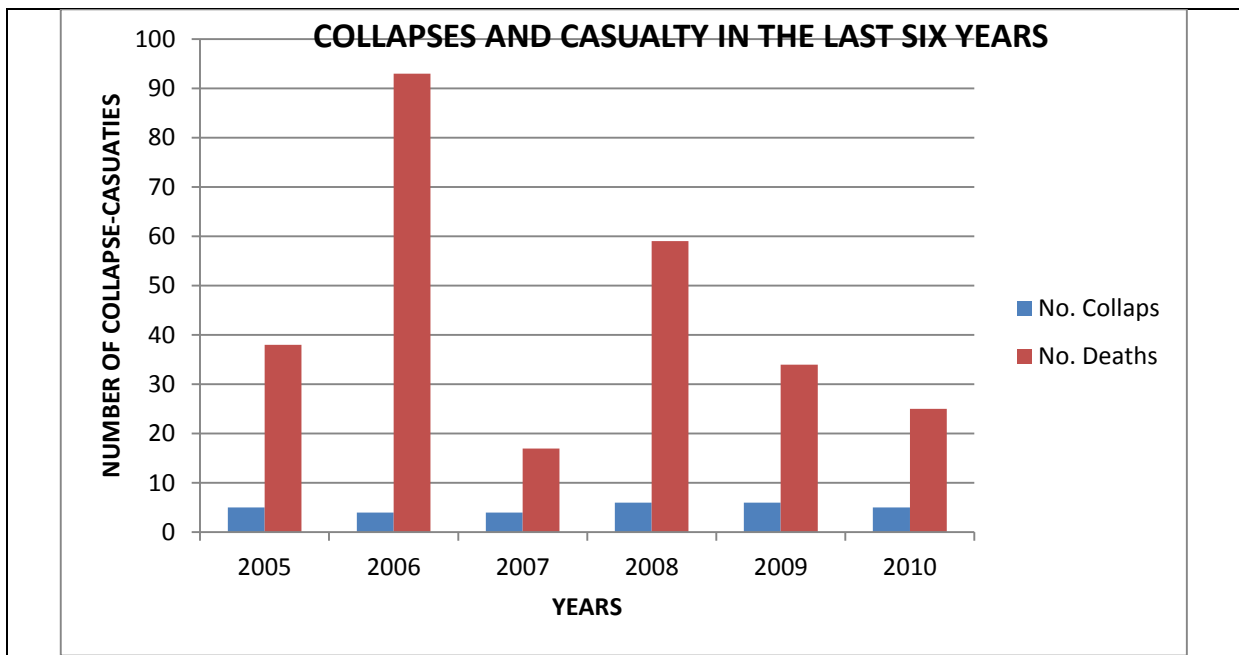


Fig. 3. Casualties verified in the last 6 years (2005 - 2010)

The distribution of casualties for collapsed buildings in the last 6 years (2005-2010) can be seen in figures 3. But we need to wait for the end of the wet season to know the real trend for this year.

From this figure, it can be observed that 2006 had the highest number of casualties and 2007 the least. For the year 2008 the number rose up sharply again. This can be

attributed to the usual way of reacting to events when they are fresh in our memory and then lapsing into slumber immediately after. After the massive casualties verified in 2006, the Governments and the stake holders must have been very cautious which brought about a great reduction in 2007 only to return to status quo in 2008.

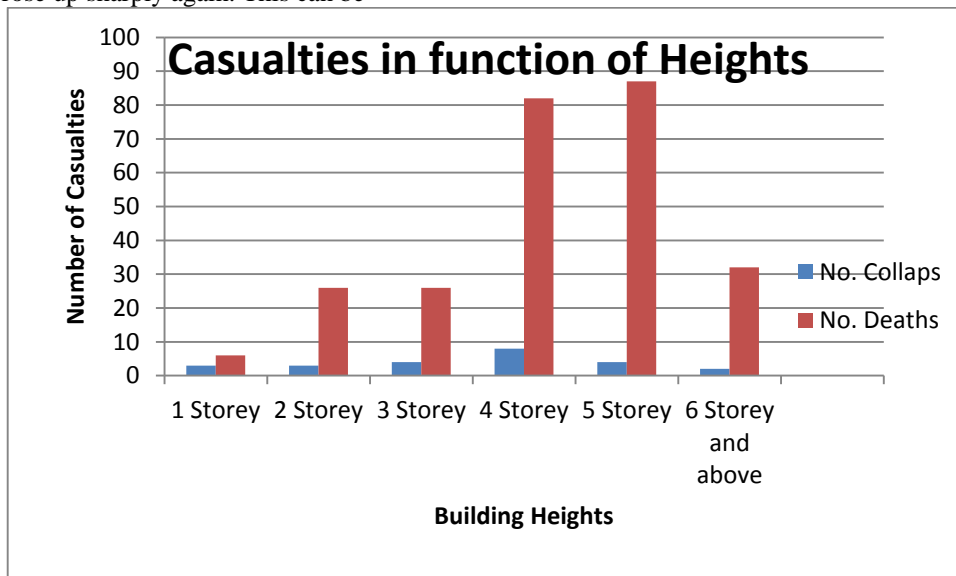


Fig. 4. Casualties in function of heights of collapsed buildings

From figure 4, it is evident that as the heights of the building increase, the casualty rate sky-rockets to a very high level. This brings to fore the risk involved in high rise buildings.

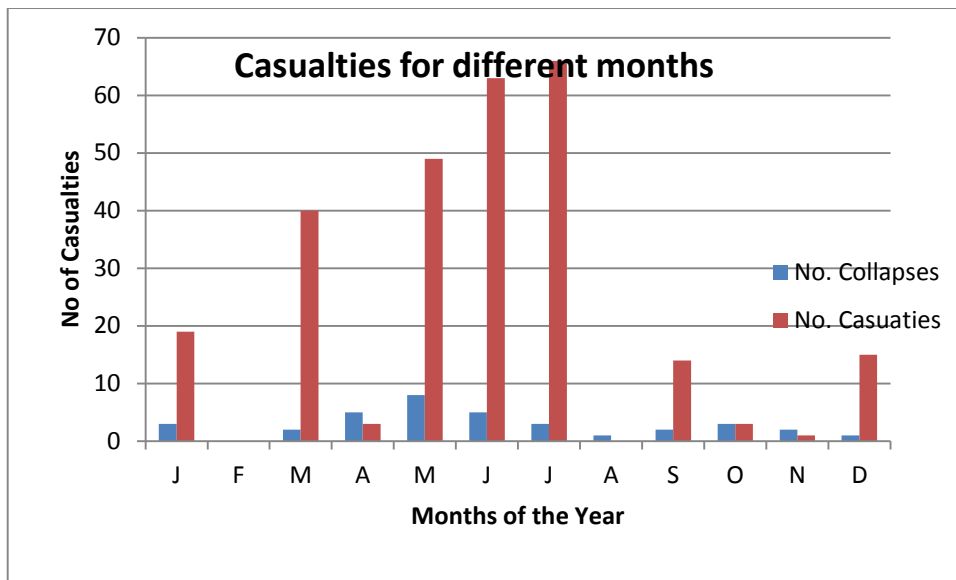


Fig. 5. Casualties for different months of the year

The distribution of the casualties in the months of the year can be seen in figure 5. From this figure, it can be seen that the months of March (the beginning of the rainy season) and the months of May, June and July (the period of heavy down pour) records the height casualties.

Figure 6 shows the trend of casualties with respect to heights of the buildings in the last decade. The trend was confirmed by the the positive value of Pearson product moment correlation coefficient ($r = 0.40$).

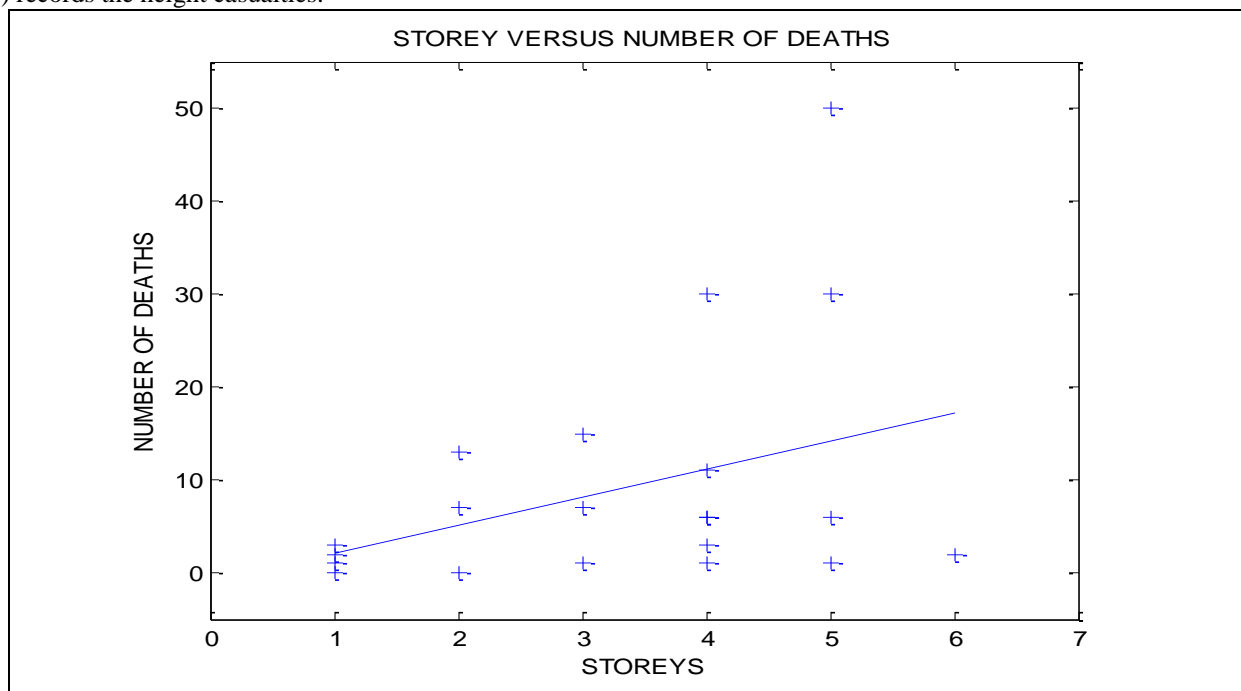


Fig. 6. Trend of casualty with respect to the heights of the building

VII. CONCLUSION AND RECOMMENDATIONS

This research has succeeded in bringing to the fore the dynamics of high death rate in the Nigerian building industry: where they occur most, the trend in the last few years, the type of structures at very high risk and the period of the year most dangerous for structures in Nigeria. This means that effective measures for the reduction of the high casualty rate must include the intensification of control and monitoring of structures of more than a storey high and rainy season constructions. It opens up the door for more interesting researches that will help to bring under control

this embarrassing situation in the country and save the lives of our citizens. Going by the results obtained from this research, the following recommendations can be made:

- ❖ The State governments with the assistance of the Federal Government should intensify efforts towards arresting the trend. This can be done through free intensive basic skill acquisition training for the artisans and more accurate monitoring of the professionals operating in the building industry as to enforce the code of practice.

- ❖ That more awareness seminar and courses be organized by the governments and the professional bodies as to enlighten all the operators and the general public on the risks in the building industry with particular emphasis on the period of heavy rainfall, so that everyone will play his/her appropriate role in reducing the incidence of building collapse and save precious human lives round the nation.
- ❖ The high rate of casualties verified for high rising buildings is directly related to the difficulties involved in realizing such edifice which can only be adequately handled by highly skilled professionals. Adequate measures need to be taken to upgrade the safety awareness of all the operators in the sector. The presence of certified safety professionals should become mandatory in every building site. This also calls for the government and the professional bodies to intensify efforts towards fishing out professionals operating in projects they are not skilled to handle.
- ❖ That law enforcement agencies be mandated to enforce eviction in houses marked for demolition, as that could have saved the lives that were lost in the most recent case.

- [8] Adeniregun, A. O., (2010). "Study Of Building Collapse In Nigeria: Effects of Poor Construction Materials and Poor Workmanship": A Student Project, Department of Civil Engineering, Covenant University, and Ota – Nigeria.
- [9] Montgomery, D., Peck, E. and Vining, G. *Introduction to linear Regression Analysis*, 3rd Ed. New York: Wiley, 2001.
- [10] Manuals for Microsoft office package 2007
- [11] Manuals for Matlab software, 2007

If these measures are put in place, the incidence of frequent building collapse and the high casualty will be reduced drastically. This will put the nation in a better position to meet up with the MDGs and be better prepared to face the unpredictable consequences of the global warming that continues to manifest itself in different ways.

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REFERENCES

- [1] Salau, M. A., (1996). "Structural Failures in Collapsed Buildings – Causes and Prevention". Seminar on collapsed Structures in Nigeria organized by the Lagos State Government and the Nigerian Society of Engineers in Lagos, Nigeria, 22nd - 23rd August 1996, pp 5 – 10.
- [2] Ede, A. N. (2010). "Structural Stability in Nigeria and Worsening Environmental Disorder: the Way Forward". The West Africa Built Environment Research Conference Accra Ghana, July 26-28, 2010, pp 489-498.
- [3] Rudrappan, D. (2010). "Save Planet Earth". http://www.google.co.uk/search?hl=it&source=hp&q=businessd+ay+nigeria&aq=2&aqi=g6&aql=&oq=businessd&gs_rfai
- [4] Ayininuola, G.M. and Olalusi, O.O. (2004). "Assessment of Building Failures in Nigeria: Lagos and Ibadan Case Study." African Journal of Science and Technology (AJST) Science and Engineering Series Vol. 5 June 2004, No. 1, Pp. 73 – 78.
- [5] Davison, B. and Owens, G. W. (2003). *Steel Designers Manual*, 6th Edition, Blackwell Publishing, London.
- [6] Olajumoke, A. M., Oke, L. A., Fajobi, A. B. and Ogedengbe, M. O. (2009). "Engineering Failure Analysis of a Failed Building in Osun State, Nigeria" Journal of failed analysis and Prevention, Vol. 9, pages 8-15.
- [7] Bukola Amusan (2010). Nine feared dead in Abuja building collapse
 - a. <http://thenationonline.net/web3/news/9389.html>