THE DETERMINANTS OF BUILDING COLLAPSE IN AKWA IBOM STATE.

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ABSTRACT

The study examined the determinants of building collapse in Akwa Ibom State. Three specific research objectives were formulated to guide the study. The research design was an Expost Facto type. The population of the study comprised of all architects, civil engineers, quantity surveyors, electrical engineers and teachers of building technology and technical education. 200 respondents incorporating the above personnel were randomly selected for the study. The instrument known as "determinants of building collapse Questionnaire (DBCQ)" was used to collect data. The instrument was subjected to reliability test, using Crombach Alpha technique method and it produced high average reliability coefficient of 0.84 which helped justify the use of the instrument. The findings from the data collection and analysis show various factors responsible for building collapse in Akwa Ibom State to include inadequate preliminary works, adoption of wrong foundation, poor concrete mix ratio, improper walling, lack of approved structural design, poor building material specification, ineffective supervision and climate. The result also proved significant influence of the factors on the incessant building collapse in Akwa Ibom State. It was concluded that there are various determinants of building collapse in Akwa Ibom State. Among others, it was recommended that Uyo Capacity Municipality should be strict in their inspection and approval of the building plans as well as giving effective supervision during the building process.

Key words: Inadequate Preliminary Works, Adoption of Wrong Foundation, Poor Concrete Mix Ratio, Improper Walling, Lack of Approved Structural Design, Poor Building Material specification, ineffective supervision, climate, building collapse.

INTRODUCTION

Buildings are structures which serve as shelter for man, his properties and activities. They are expected to be properly planned, designed and erected to obtain desired satisfaction from the environment. Collapse in building could be total or partial failure of one or more of its components leading to inability of the building to perform its principal functions of safety and stability. Ikpo (2006) defined building failure as a defect or imperfection, deficiency or fault in building elements or components. It may also be as a result of omission of performance. The degree of building failure can therefore be related to the extent or degree of deviation of a building from the "built" state which in most cases represents the acceptable standard within the neighbourhood, locality, state or country. Building collapse has so often been associated with structural failures. A structure is a whole building, complex framework or essential part of a building. The structure of the building is that part of building construction which gives the construction sufficient strength to withstand the load to which the whole building is subjected. The structure is that which carries load and transfers the load from the point of load application to the point of load support.

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 setup, building collapse are not expected within the projected lifespan of structures, but due to the imperfection in the action of human beings and the existence of so many other external factors that influence the safety of structures, failures do occur (Ede, 2010). According to Wardhana and Hadipriono (2003), collapse and distress are subsets of failure in a building. In terms of functionality, collapse occurs when the entire or a substantial part of a structure comes down thereby losing the ability to perform its function. Building collapse may be classified as total and partial collapse. Total collapse implies that several primary structural members of a building have fallen down completely while partial collapse suggests a condition where only some of the primary structural members of the building components have fallen down. Though building collapse is not peculiar to Nigeria, the trend in the country is becoming quite worrisome and a source of concern to stakeholders.

According to Ayedun, Durodola and Akinjare (2012), the spate and frequency of occurrence have become a major source of concern not only to the government but to all meaning Nigerians and most especially the stakeholders in the building industry as the magnitude of the incidents are becoming very unprecedented. That building collapse incidence is still regularly occurring despite the fact that there has been the increasing diffusion of engineering knowledge over the years has brought to question whether these stakeholders have critically examined the reasons for building failure and the roles they can play or the strategies they can articulate that would help to arrest the incidents. This seeming gap portend the reason for this article, thus this article examines the determinants of building collapse in Akwa Ibom State with the desire to finding out the causes, problems and the possible ways of arresting the situations.

Statement of the problem

The rate of building failure in Nigeria is very alarming and has resulted in the loss of lives, properties and even much financial investment is wasted. Every built structure is expected to satisfy the functional objectives that is safety, serviceability and economy, but instead the menace of building collapse in Nigeria is growing at an alarming rate, seemingly uncontrollable or beyond easy control and this has been a source of serious concern to all stakeholders, the professionals in building industry, government, private developers, clients and users, as well as neighbourhood residents. Building collapse is very dangerous and should be avoided using all necessary precautions and machineries possible. Ultimately, the effect of collapse of building structures, particularly at its completion stage and when it is occupied by users is devastating on human lives. Several productive lives and properties have been lost in the various incidences of building collapse in Akwa Ibom state and these losses which would truly be felt by future generations, have negatively impacted the socio-economic status of its citizens. Improving the qualities of lives in a city is fundamental to cities sustainability and a sustainable city is one that maintains lasting security from environmental hazards that may threaten developmental achievements. This paper therefore aims at assessing the factors responsible for building collapse in Akwa Ibom State from the stakeholders' point of view with particular emphasis on factors that could ameliorate the menace of building collapse. The study is of significance to the policy makers and other stake holders in taking proactive measures at curbing the ugly trend of building collapse in the state.

Purpose of the Study

The general objective of this study is to examine the determinants of building collapse in Akwa Ibom State. The specific objectives therefore include to:

1. Identify factors responsible for building collapse in Akwa Ibom State
2. Examine the degree of influence exerted by the various factors on this menace of incessant building collapse.
3. Make recommendations on way forward.

Research Questions

The following research questions will be answered:

What are the factors responsible for building collapse in Akwa Ibom State?

What is the degree of influence exerted by the various factors on this menace of incessant building collapse?

Hypotheses

There is no significant influence of various building hindering factors on the menace of incessant building collapse in Akwa Ibom State.

Literature Review

Basic Building Requirements

Ogunsemi (2002) disclosed the basic requirements that a building must satisfy: Each and every member of a structural system should be able to resist, without failure or

collapse, the applied loads under the service conditions. In other words, it must possess adequate strength. This demands that the materials of the structure must be adequate to resist the stresses generated by the loads. The shape and size of the structure must also be adequate. The components of the structure should be able to resist deformation under loading conditions. Deformation implies a change in size and shape when a body is subjected to stress. This means that the component should possess adequate stiffness. Thus the stiffness of a beam or column is a measure of its resistance to bending or buckling. A material or structure that is very strong but lacking in stiffness will so much deform that it will not be able to resist applied loads. All the structural members of the building must be firm, otherwise the whole structure is assumed to be unstable. Structural stability is needed to maintain shape since it is the ability of a structure to retain under load, its original state of equilibrium. It can mean anything from resistance to sliding, overturning, partial or complete collapse. Any phenomenon that can alter the load carrying behaviour of a structure, if not properly taken care of can lead to instability; a condition in which the support reaction is less than applied load. Thus to ensure stability, loads must be balanced by reactions, and the moments due to loads must be balanced by the moments due to reactions. Any building that cannot withstand the load applied up on it will show signs of distress which may lead to failure and invariably total collapse (Ukpata, 2006).

According to Akinpelu (2002), the possibility of building collapse should not be underestimated. Its occurrence is usually accompanied by loss of properties and lives. A building may collapse when one or more of its essential components fail. When buildings collapse, professional bodies such as Architects' Registration Council of Nigeria (ARCON), Council for the Registration of Engineering in Nigeria (COREN), and even Governments usually set up panels of enquiry to determine the immediate and remote causes of such failures and if possible recommend sanctions against those culpable. The rate of collapsed buildings in Nigeria has been a source of serious concern to professionals, like Architects, Builders, and Structural Engineers. Building collapse has so often been associated with structural failure. Therefore, structural failure, no doubt, are very dangerous and should be avoided using all necessary precautions and machineries possible. Ultimately, the effect of collapse of a building structure, particularly at its completion stage and when it is occupied by users is devastating on human lives. Even if lives are not lost, much financial investment is wasted. Once the specifications of the building including its materials and components are not complied with during construction, the result is building failure.

Factors Responsible For Building Collapse in Nigeria

Building collapse can be attributed to many factors. Many buildings in Nigeria have collapsed due to some of the following reasons.

i. Inadequate preliminary works: Preliminary works are operations which include site investigation and foundation. Building collapse is imminent where these operations are carried out shoddily. Site investigation is to determine the properties of the soil strata. Seeley (2006) said that all potential building sites would need to be investigated to determine their suitability for buildings and the nature and extent of the preliminary work

that would be needed. Particular attention should be given to the nature of the soil and its probable load-bearing capacities, as there may be variations over the site. The past history of the site should be investigated with particular reference to the former existence of trees, water level, borehole log, underneath soil strata and waste dumps. A careful study should be made of adjacent structure to ascertain whether failure can result due to localized conditions. According to Bell (2002), soil is an unconsolidated assemblage of soil particles between which voids. These voids may contain water, air or both. Soil is derived from the breakdown of rock materials by weathering and erosion and may have suffered some amount of transportation prior to deposition. Neville and Chatterton (2005) asserted that the development of soil mechanics which relates to the understanding of the physical properties of any particular soil type in relation to loads was really the main stepping stone towards a scientific approach to foundation problem and construction. However strong, rigid or structurally stable a building may be, its satisfactory performance depends exclusively upon the ground which supports it. Adequate site investigation prevents the issue of foundation problem because it would ensure that the most appropriate foundation is prescribed.

ii. Adoption of wrong foundation:

Lambe and Whitman (2000) defined foundation as the part of the structure in direct contact with the ground and which transmits the load of the structure to the ground which plays an important role in the construction of building structures. Foundation is expected to carry all the dead, super-imposed and wind loads from a building to the soil on which the building rests in such a way that settlement of the structure is limited, so that failure of the underlying soil is prevented. The depth of soil strata in response to the loading from the structure has to be located properly in order to safely bear the foundation of the building. Otherwise, the structure will fail.

iii. Poor concrete mix ratio:

Usually, concrete is a mixture of cement, sand, gravel and water in definite proportion. In providing support for a building, concrete is the most common material used in Nigeria. Tomilson (1980) reiterated that poor materials do not make good concrete. The cement, sand and stone must all be sound and have the types and qualities specified. The result of poor concrete works is building collapse. The steel reinforcements are embedded in concrete, so that compressive stresses are taken by concrete, while tensile stresses are catered for by steel reinforcements. For this purpose to be fulfilled, steel rods must be bent in accordance to design. Otherwise, it will fail and cause collapse.

iv. Improper walling: the wall is a very important part of the building that also provides support. Other function is to enclose or divide space. A wall that will adequately provide support is a load-bearing wall which must provide adequate strength and stability, weather resistance and durability. The commonest walling material in Nigeria now is sandcrete blocks of various sizes. As a matter of fact, walls which provide support to buildings must be straight, perpendicular and produced of sound materials. The appearance of a crack line in a building is a sign of failure. Failure in block-laying may lead to eventual collapse of the building.

v. Lack of approved structural design:

According to Ataev (2004), the basic requirement of any structural component of a building is that it should be strong enough to carry and support all possible types of loads to which it is likely to be subjected. Therefore, building design is not just the Architectural design; it also includes structural, electrical and mechanical engineering. A building that is poorly designed structurally will eventually collapse. The final object of structural analysis is to enable the Engineering design and construct a building structure, which is satisfactory in service, and that such design must be approved by the approving body. This means that it must not collapse when loads are applied and the deformation must not be excessive. In addition, some clients, in order to try and save cost, patronize quacks to do designs for them. This is very common in Nigeria and such designs are grossly inadequate and usually result in building failure.

vi. Poor building material specification:

The uses of poor building material specifications have been possible root causes of collapse. In buildings, the materials that are essentially used on construction sites are cement, sand, gravel, granite chipping, timber, iron rods and sandcrete blocks. Other materials are aluminium, glass and ceramics. Good building constructions are enhanced by materials of good quality. Proper handling and storage must be given to building materials. Material specifications must relate exactly to the intended construction and must be of adequate standard. Specifications are to prescribe what materials should be used and where there is a deviation, failure, that is, building collapse should be expected.

vii. Ineffective supervision:

Averting building collapse depends largely on effective supervision of works. Hence, improper supervision will lead to the collapse of the building structures. Supervision involves the intricate knowledge of workmanship and materials, while inspection is only to ensure adherence to contract documents, especially the drawings. The object of the supervision is primarily to ensure that employer's requirements as expressed in the contract documents are correctly interpreted and the problems which are bound to arise are satisfactorily resolved. In the case of the building under study, there was no proper supervision for the demolition works.

viii. Climate:

Apart from failure arising from negligence or negligent behaviour, many of our buildings have failed due to persistent incidence of weather. Ogunsemi (2002) remarked that a good building is not that which merely fulfils the purpose for which it is designed and erected, but a building comely and able to withstand the onslaught of weather conditions.

Methods

Research Design

The research design for this study is an Expost Facto type. This design is found fit for this study.

Area of the Study

The area of study is Akwa Ibom State.

Population of the Study

The population of the study consisted of all the architects, civil engineers, quantity surveyors, electrical engineers and teachers of building technology and technical education in Akwa Ibom State.

Sample and Sampling Technique

The respondents in the study consisted of 200 architects, civil engineers, quantity surveyors, electrical engineers and teachers of building technology and technical education. They were obtained through the simple random sampling method. Hence, the sample size of 200 respondents was used for the study.

Research Instrument

The researcher developed one instrument tagged "Determinants of Building Collapse Questionnaire (DBCQ)". The instrument was made up of two sections, sections A and B. and used for data collection.

Validation of the Research Instrument

The instrument was face and content validated by an expert in test, measurement and evaluation. The corrections and comments were incorporated into the final form of the instrument.

Reliability of the Instrument

Pearson product correlation was used to determine the reliability of the instrument (DBCQ), using 30 respondents who were not part of the main study but possess the character of the population. The reliability co-efficient was 0.84 showing that the instrument is reliable.

Data analysis technique

One research question was answered with descriptive analysis while the hypotheses were tested with chi-square analysis. The results of the statistical analysis for the hypotheses were tested for significance at 0.05 alpha level. Each result was considered significant if the calculated value was either equall to or greater than the critical value, but non-significant if the calculated value was less than the critical value.

RESULTS AND DISCUSSIONS

Research Question

The research question sort to find out the factors responsible for building collapse in Akwa Ibom State. In order to answer the question, percentage analysis was used. (See table 1)

TABLE 1

Percentage Analysis of the Factors Responsible for Building Collapse in Akwa Ibom State.

PERCENTAGE ANALYSIS			
FACTORS	**FREQ**	**%**	**Remark**
Inadequate preliminary works	132	12.15	5th
Adoption of wrong foundation	188	17.31	2nd
Poor concrete mix ratio	184	16.94	3rd

Improper walling	127	11.69	6th
Lack of approved structural design	67	6.17	7th
Poor building material specification	189	17.40	1st**
Ineffective supervision	145	13.35	4th
Climate	54	4.97	8th*
Total	**1086**	**100**	

** Highest percentage frequency

* Lowest percentage frequency

From the result of the above table 1, It was observed that the highest factor responsible for building collapse in Akwa Ibom State was Poor building material specification (17.40%), seconded by Adoption of wrong foundation (17.31%). The third in the list was Poor concrete mix ratio (16.94%), this was followed by Ineffective supervision (13.35%). Inadequate preliminary works was the fifth in the least (12.15%) while improper walling (11.69%) was the sixth factor. The seventh factor was Lack of approved structural design (6.17%) while the least factor was Climate (4.97%).

Hypothesis

The null hypothesis states that there is no significant influence of various building hindering factors on the menace of incessant building collapse in Akwa Ibom State. To test the hypothesis, chi-square analysis was performed on the data (see table 2).

Table 2

Chi-square analysis of influence of various building hindering factors on the menace of incessant building collapse in Akwa Ibom State.

Factors	**High**		**Low**		**X^2**
	Observed Freq.	**Expected Frequency**	**Observed Freq.**	**Expected Frequency**	
Inadequate preliminary works	132	135.75	68	64.25	
Adoption of wrong foundation	188	135.75	12	64.25	
Poor concrete mix	184	135.75	16	64.25	

ratio					
Improper walling	127	135.75	73	64.25	
Lack of approved structural design	67	135.75	133	64.25	446.68*
Poor building material specification	189	135.75	11	64.25	
Ineffective supervision	145	135.75	55	64.25	
Climate	54	135.75	146	64.25	
Total	**1086**	**1086**	**514**	**514**	

***Significant at 0.05 level; df = 7; Critical = 14.07**

Table 2 shows the calculated X^2-value as (446.68). This value was tested for significance by comparing it with the critical X^2-value (14.06) at 0.05 levels with 7 degree of freedom. The calculated X^2-value (446.68) was greater than the critical X^2-value (14.07). Hence, the result was significant. The result therefore means that there is significant influence of various building hindering factors on the menace of incessant building collapse in Akwa Ibom State. The significance of the result caused the null hypothesis to be rejected while the alternative one was accepted. The result therefore was in agreement with the research findings of Ogunsemi (2002) which disclosed the basic requirements that a building must satisfy. He further added that each and every member of a structural system should be able to resist, without failure or collapse, the applied loads under the service conditions. The result also agrees with the findings of Akinpelu (2002), who stated that the possibility of building collapse should not be underestimated. Its occurrence is usually accompanied by loss of properties and lives. The significance of the result caused the null hypotheses to be rejected while the alternative one was retained.

Conclusions

Collapse of building does occur in Akwa Ibom State but in rare cases. Collapse of building is caused by inadequate preliminary works, adoption of wrong foundation, poor

concrete mix ratio, improper walling, lack of approved structural design, poor building material specification, ineffective supervision and climate with the highest caused by Poor building material specification. Finally, there is significant influence of various building hindering factors on the menace of incessant building collapse in Akwa Ibom State.

Recommendations

1. Uyo Capacity Municipality should be strict in their inspection and approval of the building
   plans as well as giving effective supervision during the building process.
2. Adequate preliminary works should be done before the real building process is embarked
   upon.
3. The architects and other regulatory bodies should ensure the builder adoption of make and
   good foundation, good concrete mix ratio and proper walling.
4. The structural design should be approved before the building exercise occurs.
5. Good building material specification should be strictly adhered to as well as effective
   supervision given for good and quality delivery.
6. Building should be dome most time during the dry season and when it is not raining in order to
   encourage a firm foundation of the building.

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