Residential Building Collapse in Nigeria: Incidence, Causes, Effects, Solution and Implication for Technical Education

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ABSTRACT
The study adopted a survey research design to investigate the causes, effects and remedies to cases of residential building collapse in Nigeria, with implication for technical education. To achieve the purpose of the study, four research questions were raised to guide the study. A sample of 86 drawn from a population of 460 registered builders in Port Harcourt metropolis participated in the investigation. The sample technique adopted was simple random sampling. Questionnaire was used for data collection., The questionnaire, before used was validated by experts and a reliability coefficient of 0.825 using test- retest method and Pearson's Product Moment Correlation technique. The questionnaire was administered to the participants at a quarterly meeting of the Port Harcourt Branch of the Institute of Builders through the secretary of the institute. The mean and standard deviation were used to analyze the data. It was found that the influx of quacks in the building construction industry was the major cause of the incessant collapse of buildings experienced across Port Harcourt metropolis. It was recommended, among others, that, there should be strict adherence to the National Building Code which serves as a manual for all types of building practice including residential buildings.
Keywords: Residential building collapse, incidence, causes, effects, solutions, technical education

INTRODUCTION
The pursuit of shelter for all mankind and his activities has always been a paramount issue. Housing is widely ranked among the most critical factors that determine the quality of life, culture and welfare of a people. It is critical to meeting the social, cultural, economic and environmental needs of people and influences the wellbeing, health and security of both the present and future generation. Housing is therefore central to the concept of sustainable development, given its complex web of relationship with the four factors of sustainability, namely; social, economic, cultural and environmental. The question of housing is of paramount concern to governments across the globe. In Nigeria for instance, all successive governments since independence highlighted housing as a major priority. Unfortunately for over 59 years of its independence, Nigeria is still grabbling with its housing/building crises. The ever mounting crisis in the building sector of Nigeria has been in various dimensions, which range from absolute housing unit shortages, to the emergence and proliferation of the squatter settlements and slums, rising cost of housing rent and of course building collapse. The incidence of building collapse in Nigeria is reaching an epidemic proportion. Adebayo (2013) wrote: the spate of building collapse and failure has become an endemic problem that has defied all attempts at providing solutions in the recent past, these incidences have resulted in the loss of lives and properties which has also infringed permanent disabilities to many. 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 occurrences have become a major source of concern, not just to the government, but all

meaning Nigerians especially to the stakeholders of 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 have been the increasing diffusion of technical and engineering knowledge over the years have brought to question whether these stake holders have critically examined the reasons, effects and solutions for building failures and the roles they can play or the strategies they can articulate that will help to ameliorate these incidences. Buildings are structures, which serve as shelter for man, his properties and activities. When properly planned, designed and erected, it gives desired satisfaction to the client or user. Some of the factors to be considered in measuring the standard of a building include durability, adequate stability to prevent its failure or discomfort to the users, resistance to weather, fire outbreak and other forms of accidents (Ikpo, 2006). The styles of building construction are constantly changing with the introduction of new materials, change in climate and techniques in construction. Consequently, the work involved in the design and construction stages of buildings are largely that of selecting materials, components and structures that will meet the expected building standards and aesthetics on economy basis. Several codes of practice universally accepted are available for the design and construction of buildings.

In 2006 the Federal Republic of Nigeria published the National Building Code which hitherto is undergoing review and in the process of being passed into law by the National Assembly of the Federal Republic of Nigeria in response to the number of cases of collapsed buildings recorded in the country. This has not yielded the desired result as most States in the country have not passed the Urban and Regional Planning Law to make the National Building Code operational in their respective States. Building code is a set of legal requirements of which the purpose is to promote good practice in the design, construction and maintenance of buildings, in the interest of health, safety and welfare of people who use the buildings. The code sets out basic requirements for design and construction of buildings which represents a code of good building practice (Obiegbu, 2006).

The sophisticated nature and complexity in modern building designs introduced various lines of risks in building development process instead of eliminating or removing them. These new designs and technology associated with different types of risks could lead to building failures, abandonments outright collapses. Previous researches show that there were sharp increase in the reported cases of building collapse in Nigeria in the years 1985, 1995, 1999, and 2005, and also suggests an upward trend in the number of cases of building collapse in the year 2010. The Council of Registered Builders of Nigeria (CORBON) identified 104 incidences of building collapse based on available records in Nigeria spanning from 1974 – 2016. These observations are astonishing and most worrying.

In order to tackle the cases of building collapse and the associated risks, the Nigerian government at different periods made Laws to guide the building development to curb the menace and risks associated with building collapse. Adebola, Gambo, Ankeli and Daniel (2016) carried out analysis and evaluation of the death rate involved in 47 reported cases of building collapse verified between 2000 and 2020 and over 300 deaths were recorded for Lagos, Abuja and Port Harcourt which are the three major urban centers with high rate of casualties. Ayeni and Adedeji (2015) and Babalola (2015) noted that every aspect of building planning process from the architectural design through the electrical, structural, mechanical engineering, construction and maintenance require proper supervision and quality inputs by professionals in the construction industry.

Fadamiro (2002) defined building as "an enclosure for spaces designed for specific use, meant to control local climate, distribute services and evacuate waste". Buildings can be further defined as structural entities capable of securing self by transmitting weights to the ground. More so, buildings are defined "as structures for human activities, which must be safe for the occupants"(Odulami, 2002). However, these same buildings have been posing threats and dangers to people either during or after construction as a result of its collapse. Collapse as a whole occurs when part or whole body of a structure fails and suddenly gives way. The structure, as a result of this failure, could not meet the purpose for which it was meant for. Building collapse is an extreme case of building failure. It means the super-structure crashes down totally or partially (Arilesere, 2002). For over three decades, Nigeria has experienced frequent

building failure and collapse; 64 buildings were reported collapsed between 1974 and 2011 with fatality of about 300. Amongst the recent building collapse was a church pavilion collapse in Uyo, Akwa Ibom State which claimed about 200 lives on 10th December, 2016. Investigations are ongoing to ascertain the main causes of such failures and find a solution to them. However, not much has been achieved in tackling this kind of menace.

Many studies has been carried out and various workshops organized in major cities of the country by various bodies, government agencies and institutions in order to look into causes of the incidence of building collapse in Nigeria. however none has been able to come out with how each of the determined factors directly lead to building collapse in the country. The study is aimed at identifying the cases of building collapses across Nigeria, examining the causes, considering the effects with a view of proffering a lasting solution.

Statement of the Problem

Building collapse is a situation where building which has been completed and occupied, completed but not occupied or under construction crashes down on its own due to the action or inaction of person or due to natural events like earthquake, storm, flooding, tsunami or wildfire (Olufemi, 2018). It is a defect or imperfection, which occurs when the imposed load on a building exceeds the moment of resistance. The degree of building collapse can therefore be related to the extent of deviation from the building designs and specifications which in most cases, represents the acceptable standards within the neighborhood, locality, State or Country (Ikpo, 2018). The menace of building collapse have become a major source of concern to all stakeholders of the building industry as it has resulted to numerous loss of lives and properties especially in the last two decades which has made building occupants loose trust in the building industry as well as the technical education sector which turns out the tradesmen and craftsmen for building industry. This topic has been a trending topic in recent years as the incidences of building collapse keep skyrocketing and as such a whole lot of studies have been carried out on this topic and coincidentally their findings have not been far from each other. Mansur Hamma-adama and Tahar Kouider (2020) found out that poor (substandard) building materials remain a major cause of building collapse. They also discovered that the civil/structural engineer is solemnly associated with the components of buildings that leads to collapse and as such maximum attention should be channeled to that sector to put an end to the unpalatable trend of building collapse. Chendo and Obi (2015), in their research on this topic, recommended proper planning, supervision and monitoring by policy makers to ensure that all buildings are constructed according to design specification, professionals in the construction industry should maintain their integrity and professional ethics, the need for periodic public awareness campaign through electronic and print media to sensitize the public on the advantages of using professionals as a means of realizing safe buildings, soil investigation, material tests and environmental impacts assessment (E.I.A) should be made compulsory for all institutional, industrial and commercial buildings. Odeyemi Samson and Abdulwahab (2019) recommended that all stake holders in the building industry should adhere strictly to the building code as its negligence was a major contributor to collapse of buildings in Nigeria in addition to the fact that the regulatory bodies e.g. COREN, CORBON ARCON etc don't organize enough workshops to forestall the menace of building collapse. All these findings are pertinent towards curbing the spate of building collapse but very little have been done on the impact of technical education on building collapse as many feel it may be insignificant, but in reality, it may be the final piece in the jigsaw towards addressing this unwanted incidence. This has been a major source of worry to the researcher forming the basis of this study to identify incidences, causes, effects and probable solutions to incessant collapse of residential buildings in Nigeria.

Purpose of the Study

The purpose of the study is to investigate the cases of building collapses in Nigeria.

The objectives are as follows;

1. To identify the causes of building collapse in Port Harcourt Metropolis in Nigeria.

2. To identify the effects of building collapse on the construction stakeholders in Port Harcourt Metropolis in Nigeria.

3. To identify the remedial measures to incidents of building collapse in Port Harcourt Metropolis in Nigeria.
4 To identify the implications of building collapse to technology education in Port Harcourt metropolis in Nigeria

Research Questions
The following research questions have been provided to guide the study:
1 What are the causes of building collapse in Port Harcourt metropolis in Nigeria?
2. What are the effects of building collapse on the construction stakeholders in Port Harcourt metropolis in Nigeria?
3. What are the remedial measures to reduce incidents of building collapse in Port Harcourt metropolis in Nigeria?
4. What are the implications of building collapse to technical education in Port Harcourt metropolis in Nigeria?

METHOD AND MATERIALS
The study adopted descriptive survey research design to investigate the causes of building Collapses in the city of Port Harcourt, Rivers State Nigeria. The population of the study was 420 registered builders. The builders comprised building contractors, civil engineers and teachers in vocational and technology education. Out of this number, a sample of 86 was drawn, using simple random sampling technique.

The instrument used for data collection was of the structured format and interviewed. The structured questionnaire was a modified Likert type of the four point scale of Strongly Agreed (SA) 4 points, Agree (A) 3 points, Disagree (D) 2 points and Strongly Disagree (SD) 1 point. The instrument was validated by three experts the Departments of Civil Engineering, Vocational and Technology Education and Statistics at the Rivers State University. To confer reliability of the questionnaire, test-retest method was used. To do this, 30 copies of the questionnaire were administered twice to an equivalent group whose members were drawn from outside the target sample. The two sets of scores which were administered and collected at an interval two weeks were computed using the Pearson's Product Moment Correlation. A reliability coefficient of 0.825 was calculated, which was considered a high reliability.

The questionnaire was administered to the participants at the Quarterly General Meeting of the Nigerian Institute of Builders, Port Harcourt Branch through the secretary of the institute. The research questions were answered using mean and standard deviation, while the hypotheses were tested using Z-test at 5% level of significance.

RESULTS
Research question 1: *What are the causes of building collapse in Port Harcourt metropolis in Nigeria?*

Table 1: mean rating and standard deviation on the causes of building collapse in Port Harcourt metropolis in Nigeria.

Item	Rated	N	$\overline{X}$	SD	Remark
1.	Poor architectural and structural designs	325	3.82	0.043	Accept
2.	Poor construction method	370	4.53	0.055	Accept
3.	Unstable soil	382	4.65	0.057	Accept
4.	Poor maintenance culture	360	4.23	0.049	Accept
5.	Natural disasters	420	3.82	0.063	Accept
6.	Use of unskilled artisans/craftsmen	380	4.74	0.056	Accept
7.	Substandard/inferior materials	405	4.77	0.060	Accept
8.	Overloading of buildings	370	4.35	0.051	Accept
9.	Vibration from nearby activities	403	4.59	0.059	Accept
10.	Rise in water table level	325	4.94	0.043	Accept
11.	Exceeding of lifespan of the structure	335	3.94	0.045	Accept
	Grand mean	**370**	**4.40**	**0.048**	**Accept**

Source: field survey, January, 2021 N=86 Respondents

Table 1 shows that with a grand mean of (X = 4.40), which is higher than the criterion mean (X = 2.50), the respondents generally agreed that building collapse were caused by all the eleven factors presented in the questionnaire.

Research question 2: *What are the effects of building collapse in Port Harcourt metropolis in Nigeria?*

Table 2: Mean ratings and standard deviations of the effects of building collapse within Port Harcourt metropolis in Nigeria.

Item	Rated	N	$\overline{X}$	SD	Remark
1.	Loss of lives	340	4.00	0.046	Accept
2.	Loss of materials and capital investments	383	4.51	0.054	Accept
3.	Impromptu(unplanned)relocation	395	4.65	0.057	Accept
4.	Displacement of families	389	4.58	0.056	Accept
5.	Litigations and series of court proceedings	335	3.94	0.045	Accept
6.	Confiscation of license of professionals involved	370	4.35	0.051	Accept
7.	Psychological disorder of survivors	382	4.49	0.054	Accept
8.	Loss of self-confidence of the builder	405	4.76	0.060	Accept
9.	Lynching of builder or team member in volatile	365	4.29	.050	Accept
10.	Total economic loss to both client and contract	410	4.82	0.061	Accept
11.	Traumatic torture throughout lifetime of most victims	342	4.02	0.046	Accept
	Grand mean	**374**	**4.40**	**0.053**	**Accept**

Source: field survey, January, 2021 N=86 respondents

Table 2 above shows that with a grand mean of (X = 4.40), which is higher than the criterion mean (X = 2.50), the respondents totally agreed each of the eleven items were the effects of building collapse within Port Harcourt metropolis

Research question 3: *What are the implications of building collapse to technical education within Port Harcourt metropolis in Nigeria?*

Table 3 : Mean ratings and standard deviations of the implications of building collapse to technical education within Port Harcourt metropolis in Nigeria.

Item	Rated	N	$\overline{X}$	SD	Remark
1.	Loss of public trust in the technical education sector	373	4.39	0.045	Accept
2.	Reduces the value/relevance of the Technical education	382	4.49	0.054	Accept
3.	Call for major reviews in the Certification of graduates	359	4.22	0.049	Accept
4.	Results to polarity in opinion of stakeholders	303	3.56	0.039	Accept
5.	Invites review in the curriculum of technical Education	347	4.08	0.047	Accept
6.	Expensive investigation on certain collapses	384	4.52	0.055	Accept
7.	Overhaul of technology education Policies in the state affected	346	4.07	0.047	Accept
8.	Loss of jobs to trainers of defaulting contractors	367	4.32	0.051	Accept
9.	Call for stronger collaboration between Technical Education and industry	335	3.94	0.045	Accept
10.	Engaging expatriates into the sector if local remedy persists	349	4.11	0.047	Accept
Grand mean		**3.55**	**4.17**	**0.048**	**Accept**

Source: field survey January, 2021.   N = 46 Respondents

Table 3 above shows that with a grand mean of (X = 4.17), which is higher than the criterion mean (X = 2.50) the respondents agreed with the ten implications of building collapse for technical education within Port Harcourt metropolis

Research question 4: *What are the remedial measures or approaches to building collapse within Port Harcourt metropolis in Nigeria?*

Table 4. Mean Ratings and Standard Deviations to the Remedial Measures or approaches to Building Collapse within Port Harcourt Metropolis in Nigeria

Item	Rated	N	$\overline{X}$	SD	Remark
1.	Strict adherence to building code	401	4.72	0.059	Accept
2.	Severe punishment to defaulters	365	4.29	0.050	Accept
3.	Absolute revamp in the technology education sector	336	3.95	0.045	Accept
4.	Abolition of quackery by means of efficient task force	415	4.88	0.062	Accept
5.	Intensified publicity by professional bodies	387	4.55	0.055	Accept
6.	Actual engagement of professionals by clients	405	4.76	0.060	Accept
7.	Use of specifications in terms of materials and method	381	4.48	0.054	Accept
8.	Supervision of all workers on site	376	4.42	0.053	Accept
9.	Elimination of greed on part of the contractor	390	4.59	0.056	Accept
10.	Verification of soil bearing capacity prior to construction	409	4.81	0.045	Accept
Grand mean		**387**	**4.55**	**0.05**	**Accept**

Source: field survey January, 2021 N = 46 Respondents

Table 4. above shows that with grand mean of (X = 4.55), which is higher than the criterion mean (X = 2.50) the participants agreed that the residential building collapse can be curtailed within Port Harcourt by adhering to the measures listed out in Table 4.4 above.

DISCUSSION
The analysis as shown in Table 1 clearly reveals that all the items rated were accepted as variously caused of residential building collapse. However, when referring to the item by item analysis the three major causes of building Collapses were (1). use of substandard and inferior building materials ($\times$ = 4.77); (2) use of unskilled labour or quack trades-men and quack craftsmen (x =4,74) and 3) rise in water table (x = 4.94) The first cause corroborated Mansur, Hamma-Adam and Tahar Kauider (2027) who found that use of poor and substandard building materials remain a major source of building collapses. On the responses on the effects of building collapse on the stakeholders, all the items were found to have effects on the stakeholders. This is in agreement to the studies carried out by Osaghale, Ikpo, and Ajayi (2015); Obodoh, Amade, and Igwe (2019); and Chendo and Obi (2015). These investigations identified loss of property, loss of materials, waste of resources, time and labour and cost of litigation and cost of temporary relocation as some of the effects of building collapse in Port Harcourt Metropolis.
In the technical education sector, the investigations highlighted some major implications as a result of challenges the alarming incidence of building collapse in Port Harcourt Metropolis. It was found that reoccurring incidents in building collapse could result in reduction in the value trust on Technical Education, call for a review or total overhauling in the curriculum of Technical Education, and call for a collaboration between the Technical education and building and construction industry.

It was also observed that the menace of building collapse can be reduced by strict adherence to building code, severe punishment to defaulters, absolute revamp in the technical education institutions, creation of taskforce to checkmate quackery, intensified publicity by the construction stakeholders, engagement of professionals by clients, zero tolerance for specifications in terms of materials and procedures, improved site supervision, contentment on the part of the contractor and carrying out of proper soil tests prior to construction .

CONCLUSION
From the findings, a residential building should serve its basic purpose of providing shelter and comfort to its occupants and for a building to achieve such, it must not collapse within it expected life time, Therefore, in order to ensure that this expectancy is achieved the following measures must be adopted; Strict adherence to building code will reduce building collapse, severe punishment should be meted to defaulters from adhering to building codes and regulations. In addition there should be absolute revamp in the technology education sector as an agent for Information dissemination, from schools to work sites. This will raise the consciousness of good practice in building industry. Also there should be in place a taskforce to checkmate quackery. This, no doubt will help in reducing building collapse. There should be intensified publicity by and for stakeholders in the construction.

RECOMMENDATIONS
Base on the findings of this study, the following recommendations were made;
1. There should be strict adherence of the builders to the provisions of the building code which is a comprehensive guide to any building practitioner
2. The concerned authorities should penalize defaulters in cases of building collapses, especially ones that could have been avoided
3. The technical education institutions, being the main suppliers of labour to construction industries should accept the onerous task of providing competent craftsmen and technicians to mind the building industry.
4. The relevant bodies (NIOB, NIA, NSE, NIQS etc.) should institute effective taskforce to monitor quackery in the building construction industry
5. There should be periodic publicity where the general public are sensitized on the importance of engaging the right professionals in the building construction.
6. The clients, both in private and public sectors should always engage professionals as builders.
7. That quality building materials should be used in building construction. This function will call for regular inspection of materials by Standard Organizations of Nigeria. In this regard, there should be a proper soil testing before any building will be imposed in the site

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