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Causes, Effects and Precautionary Measures to the Collapse of Buildings in Port Harcourt, Rivers State-Nigeria

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Abstract
Building failure and collapse is as a result of the progressive deterioration of various components of a building. This study identified the major causes of building failure and collapse, it effects, and precautionary measures to prevent such occurrences.Port Harcourt was purposively sampled for the study. Data were obtained from primary and secondary sources, the primary data were obtained through the use of structured questionnaires and participants were drawn from various professionals and major stakeholders in the building construction industry in the study area. Results were analyzed using the Relative Importance Index (RII).The results of the analysis showed that the major factors responsible for building collapse are usage of substandard building materials, non-involvement of relevant and qualified professionals, defective design, and poor maintenance culture. The study also revealed the effect of building collapse to include increase in mortality rate, wage losses, psychological trauma and damaged image to the country among others. The study further suggested the following measures to prevent the collapse of buildings: Institutions and agencies should be set up with the sole responsibility to carry out regular awareness campaigns about the dangers of using quacks and substandard materials in the construction of buildings. Parliaments at state and federal levels should make laws to provide stiffer penalties for those responsible for building collapse, government agencies should ensure strict adherence to legislations on building codes and also stakeholders in the building industry should synergize and adopt a sustainability approach/ mode for every building construction project especially high rise buildings.

Keywords: *Building collapse, Causes, Substandard materials.*

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I. Introduction

A building is a human created space that provides the habitat for human and other living things to have their comfort and also be prevented from adverse effects of natural and artificial environmental conditions. Although, Nigeria is seen to have a relatively good environmental condition devoid of certain natural disasters as compared with many other countries in the world. However, the increasing spate of building collapse scattered across the length and breadth of the country is alarming, worrisome and devastating. Building collapse in Nigeria has become a perennial issue that calls for urgent attention.

Windapo & Rotimi (2012) mentioned that Lagos state recorded quite an alarming rate of building collapse between 1974 and 2010. Ifon (2018) also stated that Port-Harcourt recorded over 30 cases of building collapse between 2013- 2018. The cases of building collapse are mostly observed in big cities where there are different categories of buildings. Many lives and properties have been lost in the collapse of building mostly in Port-Harcourt, Lagos, Abuja and other major cities in Nigeria. Many property owners have developed high blood pressure and some have been sent to their early graves.

In spite of the effort to forestall the cases of building collapse by the government, professionals and other stakeholders in the construction industry, not enough appears to have been done especially in Port-Harcourt as the phenomenonis seen to be on the rise.

The basis for this paper is to identify the major causes of building collapse and suggest probable remedial measures that can be taken to curb the menace of building collapse.

II. Review Of Literature

PREVALENT CAUSES OF BUILDING FAILURE AND COLLAPSE

Many causes of building failure and collapse have been identified by different researchers. According to Fagbenle & Oluwunmi (2010), failure in building occur as a result of the building component not being adequate to perform the functions that are normally expected or required of those components.

Failure in buildings can occur during different stages of the construction of the building as well as after.

Dimuna (2010) stated that collapse is a state of complete failure, it is a situation where most components of the building have failed and the building can no longer stand as originally built. It can be seen therefore that collapse is the extreme state of failure. Windapo & Rotimi (2012)defined building failure as an unacceptable difference between expected and observed performance. This is a situation where a building component can no longer be relied upon to fulfil its principal functions. (Babatunde & Opawole (2009) mentioned that there can be no collapse of building without a prior failure of some components. They went further to assert that, the technology of construction can never guarantee complete elimination of failure because of the fact that structures settles down slightly on completion as a result of consolidation of subsoil imposed by the weight of the structure. Thus depending on the magnitude of this movement, failure can develop.

Building components tend to fail and eventually collapse due to the type of materials, design, method of construction, environmental conditions and the use to which the building is put.He went further to affirm that, all structures are designed to support loads without deforming excessively. These loads include live load which is the weight of people and object, rain and wind and dead load of the building itself, when these factors are not incorporated into the design and working drawing of the architect and engineers, the risk of building failure and collapse will increase.

Ayodeji (2011) attributed the failure and collapse of building in Nigeria to certain factors which includes foundation problems, natural occurrences, inadequate maintenance, unprofessional conduct etc.

Aniekwu & Orie (2006)identified low quality materials as the major cause of building collapse. Similarly, Kuta & Nyanga (2014) also established that collapsed buildings were mainly constructed with low quality materials. Wambua & Ogembo (2018) in their study on collapse building emphasize on substandard materials such as the major cause of building collapse. Research carried out byFadamiro (2002) identified the five major causes of building collapse to include natural phenomenon, design error, procedure error, substandard material, poor workmanship and lack of maintenance.

Oluwaseun & Olamide (2013) in their study on the causes of building failure in Nigeria observed that the building industry is full of quacks and inexperienced contractors. According to them, the involvement of quacks in building construction has led to a lot of collapse buildings in the past and present. Yakubu & Agapio see lack of professional involvement in building construction as a causal factor that hinders the construction process.In the same vein, Omeite and Windapo (2013) argued that a lack of professional participation in building construction affects the implementation of standards thereby resulting to collapse of buildings. Findings by Agapuag et al.,(1998) noted that the existence of many professionals within the industry with competing and conflicting interest can lead to professional rivalry which will in turn result to inefficiency and collapse of buildings.

From the foregoing, it is clear that the causative factors of building failure and collapse can be traced to series of related issues. This is due to the fact that, the building process from planning, design to construction and management is a complex process involving many professionals and other stakeholders with conflicting interest.

Table 1: Some cases of Building collapse in Nigeria from 2009 – 2018.

S/No	Location	Building Type	Date	Cause of collapse	Casualties
1	Diobu, Port Harcourt, Rivers State.	Bungalow	2009	Rainstorm	2 died
2	Aghaji Crescent, GRA Enugu	A fence wall	August, 2009	No proper drainage	1 died
3	Elelenwo, Port Harcourt, Rivers Stat.	2 Storey building, commercial property	October, 2010	Substandard materials, Hasty construction	Not reported
4	Isopakodowo St., Cairo Oshodi, Lagos	Building under construction	April, 2010	Use of substandard materials	4 died, 12 injured
5	Adenike St., Off New market, Oniru Estate, Lagos	Uncompleted storey building	June, 2010	Substandard materials, Non-compliance with approved building plans and weak structure	died, injured
6	Ikole St. Area 11, Abuja	Uncompleted 3-Storey Building	August, 2010	Undisclosed	5 died, 40 trapped

7	24 Alli Street V.I. Lagos	4-Storey Building	September, 2010	Structural defects/overloading	3 died
8	Maraba, Abuja	2-Storey Zenith Bank Building	2011	Undisclosed	Not specified
9	Pape, Abuja	4-Storey Hospital Building	2011	Undisclosed	Not specified
10	11 Aderibigbe St, Maryland Lagos	5-Storey Office Complex with a Pent house	2011	Structural failure, Gross serviceability limit violation	Nil
11	Benjamin Opara street, Port Harcour	One Storey Hotel Building	2012	Not specified	Not specified
12	16 Nnobi Str. Uwani Enugu	3-Storey Block of Flats	2012	Structural defects	Not specified
13	Awka, Anambra State	One storey residential building	2012	Defective materials	Not specified
14	Owerri, Imo State	3-Storey Block of Flats in a water logged area of Owerri	2012	Flooding	Not specified
15	Agbama Estate, Umuahia, Abia State	Four storey Block of Flats at Agbama Estate, Umuahia	2012	Non-adherence to building Regulation that permits only 2 floors in the area	Undisclosed number of squatters Perished
16	Abanye Street Onitsha, Anambra State	4-Storey commercial building collapsed during a downpour.	2013	Heavy Rainfall/flooding	Not specified
17	Bukuru, Jos South LGA	2-Storey School Building	September, 2013	Structural failure, Violation of Original approved plan	10 died
18	Oloto Street, Ebute Meta Lagos	3-Storey building	July, 2013	Dilapidated structure	7 died
19	House No.12 Hadeja Road Kaduna	Old 3-Storey Building	July, 2013	Old and dilapidated	3 died
20	Ikotun Egbe, Lagos	6-Storey Synagogue Guest House Building	September 2014	Structural failure	116 died 100 injured
21	Maryland, Enugu	3-Storey Building Under construction	April, 2015	Unknown	Not Specified
22	Dolphin Estate, Ikoyi Lagos	Residential building of Senior Politician	July, 2015	Gas Explosion	3 injured
23	Ebute Meta Lagos	3-Storey Building	July, 2015	Weak Structure	Nil
24	Oduma, Aninri LGA, Enugu State	St Anthony Catholic Church, Oduma	2015	Unknown	5 died
25	Lekki Gardens	5-Storey building	March, 2016	Violation of approved	34 died
	Lekki Phase 1, Lagos State	Under construction		number of floors	
26	Itoku Market, Abeokuta, Ogun State	4-Storey Shopping Plaza	May, 2016	Under investigation	1 died
27	444 Crescent, Citec Villas, Gwarimpa, Abuja	Six Storey Hotel Building	August 26, 2016	Poor quality materials	Five trapped
28	Uyo, Akwa Ibom State	Reigners Bible Church, Uyo	December, 2016	Poor materials	60 died, Many injure
29	Nkpokiti Estate, Enugu	2-Storey building	March 24, 2017	Not disclosed	2 site workers injured
30	Richard Abimbola St. Ilasa, Lagos	3-Storey Building	May 29, 2017	Unknown	Not specified
31	3 Massey St. Lagos Island	4-Storey Building	July 25, 2017	Not disclosed	6 died

32	Apo Mechanic Village Abuja	A storey building	July, 2017	Not Known	4 trapped
33	Hospital Junction, Umuguma, Owerri	3-Storey building Hotel Extension	July 7, 2017	Unknown	Unknown
34	Ulakwo Junction, Owerri North LGA, Imo State	Four & three Storey buildings under construction	July, 2017	Not ascertained	Unknown
35	Oforola, Owerri West LGA, Imo State	A storey building	July 8, 2017	Unknown	3 died
36	Fire Service/ Mbaise Road, Owerri	2- Storey Building	August 13, 2017	Unknown	4 died
37	9 Egbu Road, Owerri	3-Storey building	August 13, 2017	Unknown	3 died. 6 injured
38	31 Ilufe Street Ojo Alaba, Lagos	A residential building	August 28, 2017	Unknown	Nil
39	Owelle Aja Layout, Obosi, Anambra State	4-Storey building	July 17, 2018	Substandard Materials, Under the rain and sun for many years, originally had foundation for two floors and later two extra floors added.	Nil
40	Jabi, FCT, Abuja	4- Storey building	August 16, 2018	Substandard materials	2 died and many trapped in the rubbles
41	Ifite Awka, Anambra State	3 - Storey Building	October 2018	Substandard material	Nil
42	Okpuno, Otolo in Nnewi, Anambra State	3 – Storey Building	October 18, 2018	Substandard materials	Nil
43	Woji Road, GRA Phase 2, Port Harcourt, Rivers State	7 – Storey Building	November 23, 2018	Not disclosed	5 died and several others injured

Source: (W/indapo & Rotimi, 2012, Ifon, 2018)

EFFECTSOF BUILDING COLLAPSE ON SOCIO-ECONOMIC DEVELOPMENT

Many lives have been lost as a result of building collapse and the nation also loses the contribution that could have come from those victims towards socio-economic development (Ede 2010)

The increasing rate of death from building collapse in Nigeria runs against the United Nation millennium development goal programs aimed at reducing the mortality rate and improving the safety and life expectancy of world population.

Akande et al., (2010) in their study identified loss of lives and properties, discouragement in landed property investment and scarcity of properties as the effect of building collapse.

Jansen et al., (2012) categorized the consequences of building collapse into: Human, economic and environmental damages.

According to them, the human damage is concerned with fatalities, injuries and psychological damages while the economic consequences include the tangible factors such as cost of rebuilding, cost of loss of functionality and intangible factors such as loss of reputation, market price effect etc. They also considered the economic effect to mean the cost of business interruption, cost of wage loss etc. the environmental damage addresses the emission of co_2 and also the release of other toxic pollutants following building failures and collapse.

Studies from several researchers have shown how devastating and multifarious the effect of building collapse is on socio-economic development. Hence, the need to devise possible strategies to mitigate this ugly incidence calls for serious attention.

REMEDIES TO BUILDING FAILURE AND COLLAPSE

Reported cases of building failure and collapse in Nigeria revealed that building collapse can be traced to several issues which are mainly man-made. Adewumi (2009) also mention that building collapse in Nigeria are man-made and not natural disaster, as such can be prevented.

Basirai et al., (2016) in agreement with Adewumi (2009) mentioned the following steps as possible remedial measures that can be taken to curb the menace of building collapse. Frequent maintenance, good design, soil test, quality building materials and involvement of qualified professionals in the construction process. Ejiofor (2008) enumerated several measures that can be taken to include the following: professionals must be fully engaged in designs, costing and construction. Certified structural engineers should be utilized whenever the initial form of building is being altered, most importantly in multi-storey buildings. He also went further to state that stakeholders in the construction industry in Nigeria should synergize to work for the growth of the industry.

Ayodeji (2011) recommended that the Standard Organization of Nigeria (SON) need to put up a more positive and proactive approach in sanitizing building materials that are offered in the market for sale. He also recommended that the Nigerian Institute of Builders and the Nigerian Institute of Structural Engineers (NISE) should be involved in the building material sanitization process by the federal government and that material engineers should be attached to large building projects.

The recommendation of Ayodeji (2011) is in line with the views of Kuta & Nyanga(2014) that the collapse of building is connected to the entry into the market to purchase building materials that do not meet set standards. In other words, collapsed building according to them are caused by low quality building materials.

Fernandez (2014) acknowledged that many forensic investigation carried out attribute the collapse of building to low quality materials. From the aforementioned, it is quite clear that the causes of building collapse in Nigeria is mainly man-made and can be prevented.

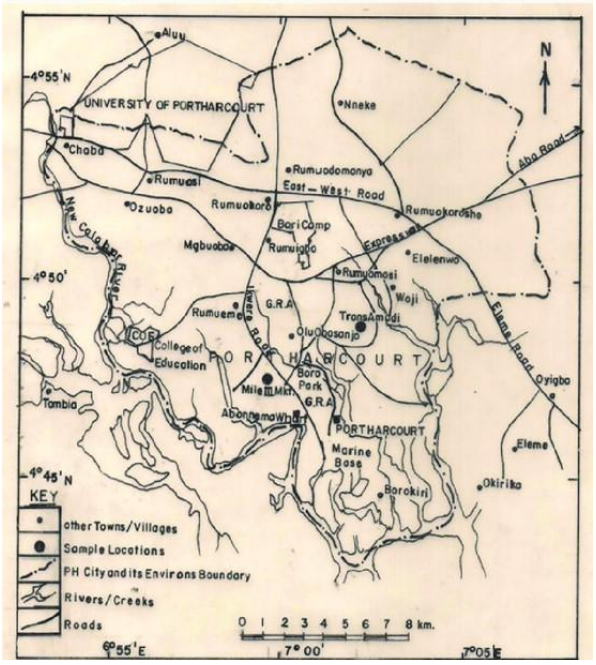
STUDY AREA

Port-Harcourt is the capital city of Rivers State. It has a population of 1,382,592 people according to NPC (2006) and lies along the Bonny river, an eastern distribution of the Niger river. 41miles (66km) upstream from the gulf of guinea.It can be located with a GPS coordinate of $4^0 4927\ 0012^0$N and $7^0 21\ 0.996^0$E.

Port-Harcourt is bounded in the South by Okrika, to the East by Eleme, to the West by Degema and to the North by Obio-Akpor. It is a seat of commercial activities in Nigeria and also a large industrial centre with a good number of multinational companies carrying out activities related to petroleum product which is currently the mainstay of Nigeria's economy

The city of Port-Harcourt has attracted a large chunks of the Nigeria's population due to rapid industrialization and is considered appropriate for this study because of the negative impact of building collapse on the overwhelming population and socio-economic development

Fig. 1. Map of Port Harcourt showing the study area.



Source: Rivers State ministry of land and survey, Port Harcourt

III. Methodology

The study is quantitative in nature, a structured survey research design is adopted in which professionals and other stakeholders in the building construction industry were provided with questionnaires to share their experiences. The professionals were drawn from both the public and private sector. Those in the public sector include certified and senior officers in the ministry of works and ministry of land and housing respectively. While those in the private sector are engineers and other building construction related professionals in private practice.

Participants mainly include: Architects, Quantity Surveyors, Town Planners Civil and Structural Engineers, Property owners, Building Engineers, Estate Surveyors and Valuers and building contractors drawn from both the public and private sector in Port-Harcourt, the study area.

A total of one hundred questionnaires were administered to various categories of respondents and data were obtained from 90 who filled and returned the questionnaires. This represents 90% response rate which was considered good enough for reliability and valid conclusion.

Data obtained were analyzed using descriptive statistics: Tables, charts and likert scale analysis. The likert scale analysis helped to scale the opinions of various stakeholders in the building construction industry.

IV. Data Analysis And Discussion

Analysis of data for this study is presented in two sections. Section A contains the demographic information of respondents while section B contains the analysis of data from various categories of respondents on the causes, effects and remedial measures to prevent the collapse of buildings.

The analysis of survey results are presented below

SECTION A

Table 2. AGE OF RESPONDENTS

AGE OF RESPONDENTS	Frequency	Percentage
15 – 20	Nil	Nil
20 – 35	13	14.4
35 – 55	55	61.1
55 and above	22	24.4
Total	90	100

Source: Researchers Field Survey 2020

Figure 2: Bar Chart showing age of respondents

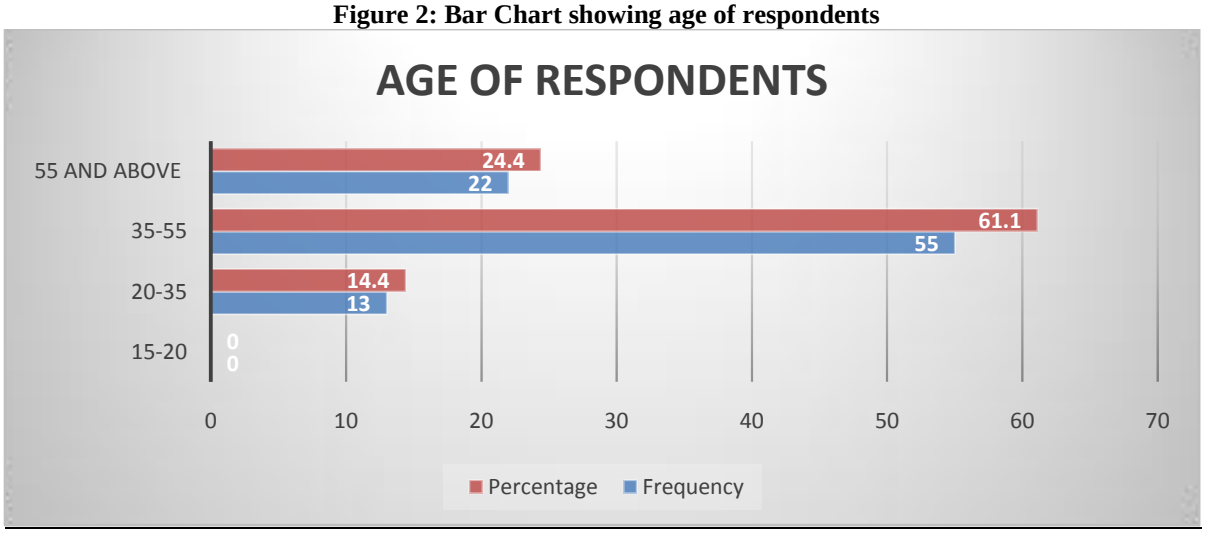


Table 2 and figure 2 above shows that 14.4% of the respondents fall within the age of 25 – 35. 61.1% fall within the age of 35 – 55 while 24.4% fall within the age of 55 and above.

Table 3. EDUCATIONAL QUALIFICATION OF RESPONDENTS

Educational Qualification of Respondent	Frequency	Percentage
FSLC	Nil	Nil
O' Level	5	5.6
BSC/HND	40	44.4
MSC	32	35.6
PhD	13	14.4
Total	90	100

Source: Researcher's Field Survey, 2020

Figure 3: Bar Chart showing educational qualification of respondents

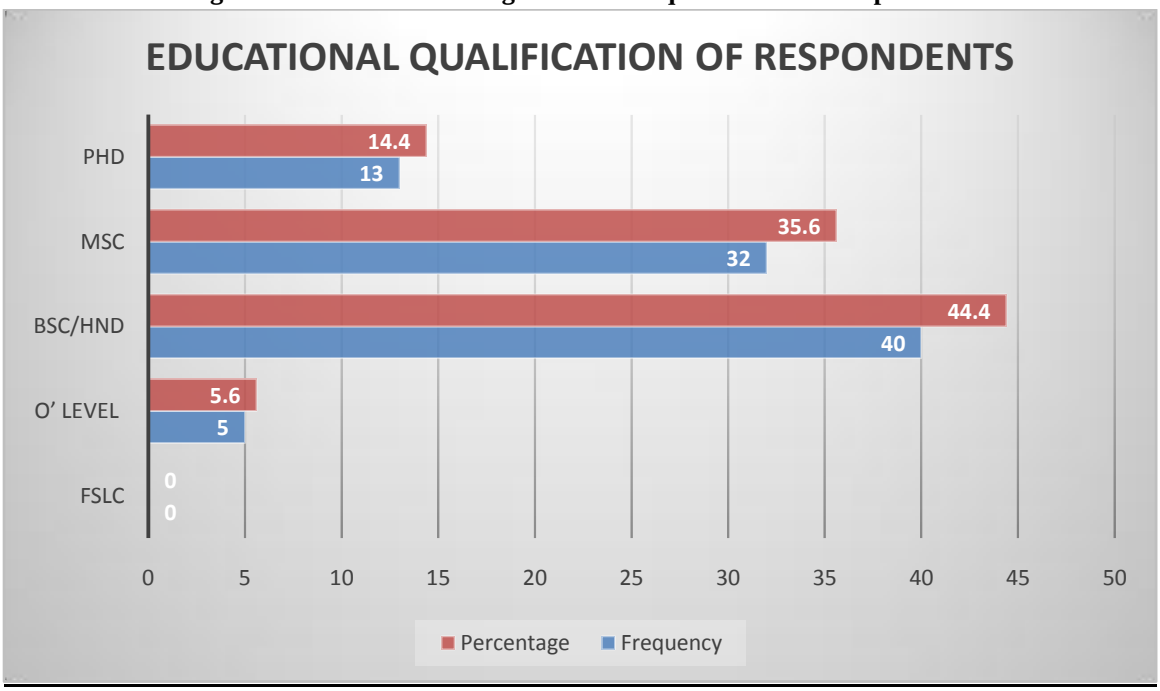


Table 3 and figure 3 above shows that 5.5% of the respondents have o' level, 44.4% have BSC/HND. 35.5% have MSC while 14.4% have PhD.

Table 4. STATUS OF RESPONDENTS

Status	Frequency	Percentage (%)
Professionals	60	66.7
Contractors	20	22.2
End users	10	11.1
Total	90	100

Source: Researcher's Field Survey, 2020

Figure 4: Bar Chart showing status of respondents

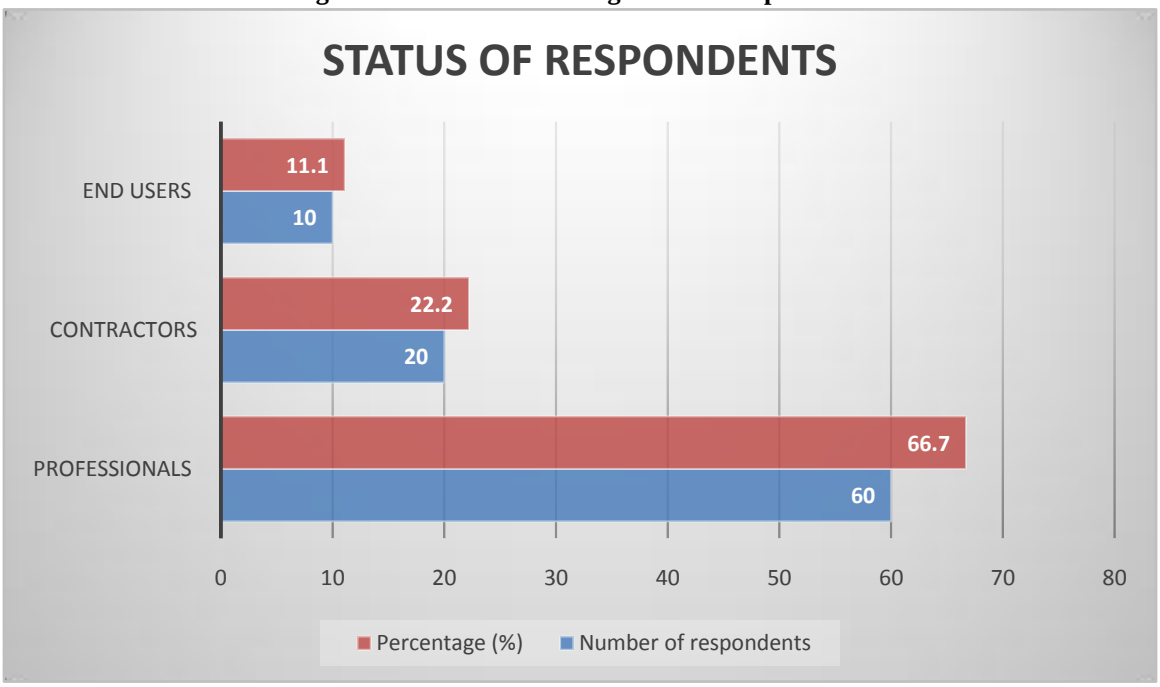


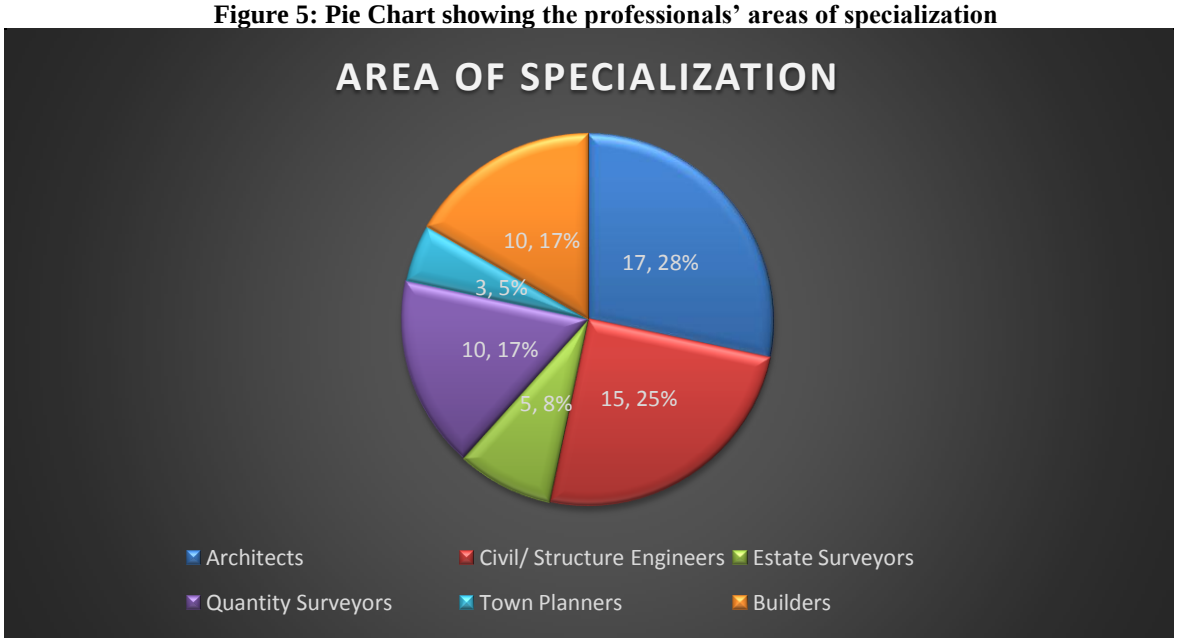
Table 4 and figure 4 above shows that 66.7% of the respondents are related professionals in the construction industry, 22.2% are contractors while 11.1% of the respondents are end users.

Table 5. AREA OF SPECIALIZATION (PROFESSIONALS ONLY)

Specialization	**Frequency**	**Percentage**
Architects	17	28.3%
Civil/ Structural Engineers	15	25%
Estate Surveyors	5	8.3%
Quantity Surveyors	10	16.7%
Town Planners	3	5%
Builders	10	16.7%
Total	60	100%

Source: Researcher's field survey, 2020

Figure 5: Pie Chart showing the professionals' areas of specialization



From table 5 and figure 5 above, 28% of the respondents are Architects, 25% are Civil/ Structural Engineers, 17% are Quantity Surveyors, 8% are Estate Surveyors while 5% are Town Planners.

WORK EXPERIENCE

Table 6. PROFESSIONALS AND CONTRACTORS ONLY

Work Experience	**Frequency**	**Percentage**
1 – 5 years	10	12.5%
6 – 10 years	40	50%
11 – 20 years	20	25%
21 and above	10	12.5%
Total	80	100%

Source: Researcher's field survey, 2020

Figure 6: Pie Chart showing the respondents work experience

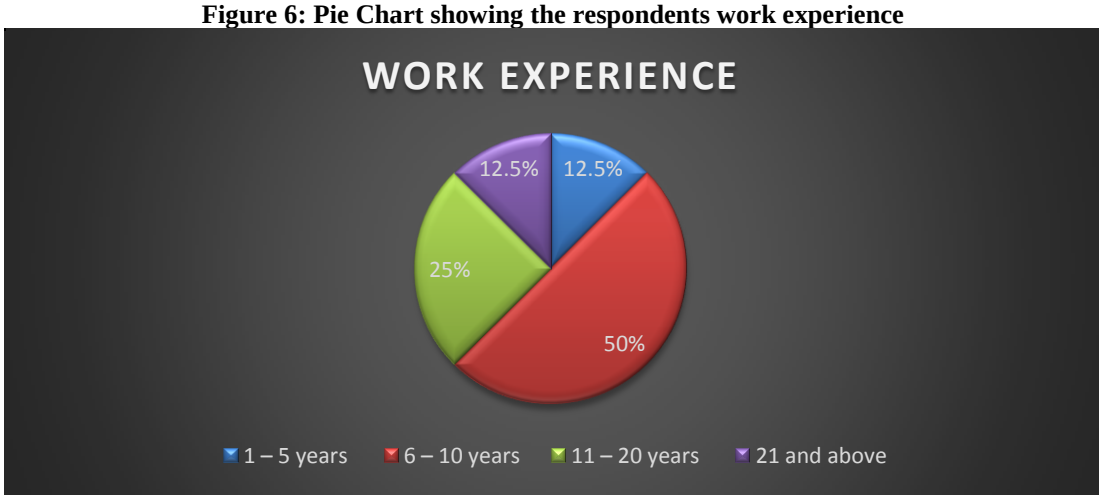


Table 6 and figure 6 above shows that 12.5% of the respondents have 1 -5 years work experience in the construction industry. 50% have 6 -10 years work experience, 25% have 11 – 20 years work experience while 12.5% have 21 years and above work experience.

Section B

This section shows the survey result of various causes of building failure and collapse, it effects and remedial measures that can be taken to prevent such occurrences. A five point likert rating scale was used and the responseswere scaled as follows, Strongly Agree (5) Agree (4), No Opinion (3) Disagree (2) Strongly Disagree (1).

Based on the five point likertscale that was adopted, a standard method of ranking was used which is the Relative Importance Index (RII)

RII is defined by the relationship below

relative Importance Index (RII) = $\frac{\varepsilon w}{AXN}$

Where W is the weight given to each element by the respondents, A is the highest weight while N is the total number of respondents.

Table 7. CAUSES OF BUILDING COLLAPSE

S/N	FACTORS	5	4	3	2	1	SUM	MEAN	RII	RANKING
1	Usage of substandard building materials	40	30	12	8	0	372	4.13	0.826	1st
2	Poor supervision and non-involvement of professionals	35	30	10	12	3	341	3.78	0.757	2nd
3	Defective design	30	30	10	12	8	332	3.68	0.737	3rd
4	Lack of maintenance culture	25	25	10	15	15	302	3.35	0.67	4th
5	Incompetent contractors	20	20	30	5	15	295	3.27	0.65	5th
6	Natural disaster	25	15	15	20	15	235	3.16	0.63	6th

Based on the computed relative important index in table 7 above, it is clear that the usage of substandard building material is the highest in ranking and as such it is considered the major cause of building failure and collapse followed by poor supervision (2nd), defective design (3rd), lack of maintenance culture (4th), incompetent contractors (5th) and natural disaster (6th) which is the most insignificant factor.

Table 8. EFFECTS OF BUILDING COLLAPSE

S/N	FACTORS	5	4	3	2	1	SUM	MEAN	RII	RANKING
1	Fatalities/ increase in mortality rate	45	35	0	5	5	380	4.2	0.84	1st
2	Psychological trauma	42	30	5	10	8	373	4.14	0.828	2nd
3	Wage losses	40	30	3	10	7	356	3.95	0.791	3rd
4	Damaged image to the country	35	25	10	5	15	330	3.6	0.73	4th
5	Loss of materials and capital investment	30	18	10	22	10	306	3.4	0.68	5th
6	Lack of trust in the industry	15	10	17	33	15	247	2.74	0.548	6th

From the analysis in 8 above, fatalities/ increase in mortality rate is the highest in ranking and seen as the major effects of building collapse. The second in ranking is psychological trauma followed by wage losses, damaged image to the country, loss of materials and lack of trust in the industry which is the 6th in the ranking order and also seen as the most insignificant effect of building collapse.

Table 9. REMEDIAL MEASURES

S/N	FACTORS	5	4	3	2	1	SUM	MEAN	RII	RANKING
1	Regular awareness campaign on the dangers of using quacks and substandard materials in building construction	44	38	0	2	6	382	4.24	0.848	1st
2	Stiffer penalties for whoever is responsible for building collapse	40	35	5	5	5	370	4.1	0.82	2nd
3	Effective enforcement of government legislation on building codes	33	30	10	7	10	339	3.76	0.753	3rd
4	Town planning officials be allowed to perform its duties without undue interference	25	20	10	15	20	285	3.16	0.63	4th
5	Soil integrity test to be conducted to ensure suitable soil for proposed development	20	15	12	25	18	264	2.93	0.586	5th
6	Stakeholders in the building industry should synergize and adopt a sustainability approach	20	20	10	10	30	260	2.8	0.57	6th

The analysis on remedial measures to prevent building collapse in table 9 above has shown clearly that regular awareness campaign on the dangers of using quacks and substandard materials is the highest in ranking and seen as the best approach towards preventing building collapse. The second is stiffer penalties for whoever is found culpable for being responsible for the collapse of a building. The third is effective enforcement of government legislation on building codes. The fourth is town planning officials be allowed to perform their duties without undue interference while the fifth in ranking is soil integrity test to be conducted and lastly stakeholders in the building industry should synergize and adopt a sustainability approach.

V. Summary Of Findings

The causes of building collapse have been identified by several researchers in the review of literature. The likert scale analysis in table 7 on the causal factors of building collapse is in line with the factors highlighted by Bamidele (2010) and Fadamiso (2012) who summarized the causes of building collapse into two categories, poor quality materials and poor workmanship. The reported cases of building collapse in the study area and other parts of the Nigeria as shown in table 1 has also revealed the main causes of building collapse to include poor quality materials and poor workmanship.

Building collapse is seen to be a menace to the society and has very calamitous effects. According to the analysis in table 8, the major effects of building collapse are increase in mortality rate, wage losses and psychological trauma. This is also in line with the ideas of Jansen, Dywer and Chrysanthropus (2012) in their study on the consequences of building collapse.

As graving as these effects are on human lives and economic development, they can be prevented. Adewumi (2009) in his submissionalso mentioned that building collapse in Nigeria are man-made and not natural disaster and as such can be prevented.

The analysis in table 9 has revealed some remedial measures that can be taken to prevent the collapse of building in the study area and Nigeria.

VI. Conclusion And Recommendations

The study takes an in-depth investigation into the causes, effects and precautionary measures to prevent the failure and collapse of buildings. Building development is complex and multifarious in nature and as such requires a very holistic approach to ensure the production of a robust structure. The major factors responsible for building collapse as revealed in the study are usage of substandard building materials, non-involvement of relevant professionals, defective design and poor maintenance culture among others. These factors can be traced to the poor attitude of professionals and other stakeholders in discharging their duties. It can be deduced that the causes of building collapse as revealed in the study is mostly man-made, thereby making it plausible for precautionary measures to be taken to possibly ward-off these undesirable occurrences.
Having looked at the issues surrounding the incidences of building failure and collapse in Port Harcourt, the following recommendations have been made.

1. Professionals and other major stakeholders in the building construction industry including government agencies should corporate and set up an institution that will be responsible for regular awareness campaigns on the dangers of using quacks and substandard building materials in building construction
2. The national and state assemblies should pass a resolution that will provide stiffer penalties for whoever is found culpable for the collapse of a building
3. The government agencies should ensure effective enforcement of government legislation on building codes.
4. Soil integrity test to be conducted to ensure suitable soil for proposed developments.
5. Stakeholders in the building industry should synergize and adopt a sustainability approach for every building construction process.

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