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APPRAISING THE CAUSES, EFFECTS AND REMEDIAL MEASURES OF COLLAPSE BUILDING IN NIGERIA

By

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ABSTRACT

Incessant cases of Collapse of buildings are issue of serious concern in Nigeria construction industry today. A building when properly constructed should be able to last for a longer period of time without any sign of deformation. A building is considered to be collapse when any of its part or the entire structure has fallen down and subsequently failed to serve its intended purpose. This study appraises the view of construction professionals in the building industry regards to the causes, effect and possible measures to the incessant cases of building collapse in Nigeria. Data for this research study were obtained through a well-structured questionnaires distributed to 81 selected sampled construction professionals within Abuja FCT. Findings from the analysis shows that the major causes and effect of building collapse is defective construction and loss of live & property. It was then recommended that emphasis should be made on the need for increased awareness on the importance of engagement of professional to handle a construction work from inception to commissioning of the project which can be achieve through the participation of various relevant professional bodies.

Keywords: Incessant, Building Collapse, Construction Professionals,

1. Introduction

The incessant cases of building collapse in Nigeria in the recent time had become a very issue of concern to the stakeholders in construction industry. Many lives and properties have been lost as a result of this menace mostly in Abuja, Lagos and Kano. Many property owners, aside financial indebtedness have developed health challenges and some have been sent to early grave (Kingslay, O. Dimuna, 2010). Despite continuous development of new technologies, many buildings still fail to achieve their primary function of providing life and safety to its occupants (Chin, Y. T.; Shen, S. L.; Zhou, A.; Chen, J., 2019). For instance, a 20-storey office building undergoing renovation works in Rio, Brazil was reported to have crashed into another 10-storey building which in turn caused the collapsed of a 4-storey building; three (3) buildings in all. This resulted in a wave of rubbles and dust in the neighbourhood, killing not less than 17 people (Chai et al., 2014). China on the other hand had also experience recurrent building collapses attributed to to 3 main reasons; age of the building, unreasonable structural design and natural disasters (Atangana et al., 2021). A four storey residential building in Jordan's capital, Amman was reported to have collapsed, killing five people and wounding 14 others. The neighbourhood populated by expatriates and locals alike had its commercial activities (cafes, bars and artistic venues) disrupted for months due to risk of exposure. Preliminary findings at the site revealed the concerned building structure have been use for decades with little attention to maintenance. Cases of building collapse in Nigerian are prevalent with attendant cases of loss of lives and properties destroyed. For example, on 12 September 2014, a guesthouse located within Synagogue Church of All Nation (SCOAN) premises around the Ikotun-Egbe area of Lagos State crumbled (Chioma, et al.,2014). This incident claim about 115 lives and 131 injured. However, report unequivocally attributed the cause to structural failure (SCOAN Coroner Judgement, 2015). On 30 August 2022, a building under construction also collapsed at the GSM market on Beirut road, in Kano State. Many people were trapped in the rubble (Iko osamede media, 2022). Preliminary finding during observed additional floor was being added to the earlier 4 floors in use. As at the time of conducting this study, the joint committee constituted by NIOB/CORBON was yet to turn in the report of

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its investigation. The paper intends to examine the causes, effects and possible remedial measure required towards reducing the cases of building collapse to the nearest minimum.

2. Statement of the Problem

The rate at which cases of building collapse incidents occur in Nigeria is of great concern to construction professional. The loss of life and huge sum of money, time wastage, loss of integrity and reputation, psychological trauma, loss of jobs and investment are some of the many apparent problem associated with building collapse. It is therefore an urgent need on any government authority to put in place relevant regulation and well in ensuring compliance with same so that the problem of building collapse can be minimize.

Madu, (2005) identified causes of building failure as due to natural disaster such as earthquakes, tornadoes, flood, etc. other causes according to him include factors such as omission, carelessness, leading to use of deficient structural drawings, absence of proper supervision of projects, alteration of approved drawings, use of substandard materials, corruption in the Nigerian system, building without approved drawings and translocation of building plans to different sites. However, this paper examines, what could be the major causes of building collapse in Nigeria and most possible effects and remedial measures.

3. Literature Review

According to Dimuna, (2010), a fundamental principle of building design is that a building should be designed and constructed to meet its owner's requirements and also satisfy public health, welfare and safety requirement. No part of such building should pose a hazard to its occupants (Fredrick et al 1989). Collapse is a state of complete failure, when the structure has factually given way and most members have caved-in, crumble; the building can no longer stand as originally built (Ede, 2010). Oloyede, et al 2010 ascertained that causes of building failure had been attributed to either natural or man- made phenomena. A natural phenomenon may consist of earthquakes, and typhoons, earth tremor and hurricane oftentimes attributed to acts of God. The man-made incidences on the other hand involve catastrophes emanating from man's carelessness. These are mostly building collapse attributable to structures constructed with low quality building materials, quacks/incompetent craftsmen instead of engaging professionals with knowledge of the existing building codes. As such, the man- made disasters of building collapse may be triggered from man's limited knowledge or negligence of such important components as soil type, building design and planning for extra ordinary loads and stress from strong winds and earthquake for tall buildings, foundation works, quality of building materials, strict monitoring of craftsmen and quality of workmanship. Some worldwide cases of building collapse detailing the year, the type of structure, the location, and remote casualties are tabulated in Table 1 below.

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Table 1: Selected Cases of Building Collapse around the World

YEAR	STRUCTURE	LOCATION	TYPE	REMOTE CASUALTIES
2000	1601 Park Avenue Apartment Building	Los Angeles, California	Residential	1 dead and 36 injured
2001	Versailles Wedding Hall Building	Jerusalem, Isreal	Wedding Hall	23 dead, 380 injured
2001	World Trade Center	New York City, New York, USA	Skyscraper	2,763 dead
2003	Hengzhou Towers	Hengyang, China	Mixed-use Apartment	20 dead
2005	Margalla Towers	Islamabad, Pakistan	Residential	78 dead, 100+ injured
2006	Bad Reichenhall Ice Rink Roof	Bad Reichenhall, Germany	Stadium Roof	15 dead, 32 injured
2006	Basmanny Market roof	Moscow, Russia	Market Roof	66 dead, unknown injured
2011	Canterury Television Building	Christchurch, South Island New Zealand	Commercial building	115 dead (during earthquake)

The numerous cases of building collapse in Nigeria over the years have led to loss of lives and properties at same time impacting negatively on the socio-economic status of the citizenry. According to Ikpo and Ajayi (2015) no life was lost in 20.3% of building collapse, between one and five lives were lost in 44.4% of the incidents while over 21 people died in 9.3% of incidents. Windapo and Rotimi (2012) argued that even where there were no incidents of death in the event of building collapse, there would be loss of productive time which does not augur well for sustainable development goals. Table 2 gives a breakdown over the years.

Table 2: Selected Cases of Building Collapse in Nigeria

YEAR	STRUCTURE	LOCATION	TYPE	CASUALTIES	REMOTE CAUSES
2014	Six-Storey Guesthouse of Synagogue Church	Ikotun-Egbe Lagos	Public	115 dead and 131 injured	Structural failure
2016	Five –Storey building under construction	Lekki Gardens Horizon 1 Lagos	Residential	34 dead several injured	Strong Windstorm
2006	Four-Storey building (Titanic)	Ebute Meta Lagos	Residential	28 people dead	Faulty Construction
2010	Four-Storey Uncompleted building	No. 2 Ikoli Street, Off Gimbiya Street, Garki Abuja	Commercial	0	Structural failure
2013	Five –Storey building under construction	Agbama, Umuahia, Abia	Residential	7 people dead several injured	Non-Adherence to building Regulation
2011	Abandoned Church building	Angwan Dosa, Kaduna	Public	5 dead	Demolition gone wrong
2014	Two-Storey School building	Abu Naima Primary & Secondary School in Bukuru Jos South LGC	Block of Classroom	10 dead	Structural defects due to conversion
2006	Top nine floors of a 21-Storey building of Bank of Industry	Broad Street, Lagos Island	Commercial	2 people dead 28 injured	Fired gutted 2 floors, heavy rain & wind after fired weakened the structured
1977	Building at Barnawa Housing Estate	Barnawa, Kaduna	Residential	28 people dead	Defective material
1990	Three-Storey building	Benjamin Okpara Street, Port Harcourt	Residential	50 people dead	Structural failure

Source: Researcher's Secondary data 2021

It is observed that most of the reviewed papers identified all the possible causes of building collapse, but this paper intends to identify the most leading cause of collapse, effects, and remedial measures of collapse of building in Nigeria.

3.1 Causes of Building Collapse

i. **Defective Design**: Building collapse incident can occur when architectural or structural drawings are based on false assumptions of soil strength, faulty structural details or poor feasibility studies before commencement of construction work. Oyewande (1992) identified design defaults as accounting for 50 per cent of collapse of engineering facilities in Nigeria.

ii. **Defective Construction**: this happens when contractor fails to execute the construction works according to architect or structural engineer's instructions. Defective construction can also occur due to poor material usage, poor workmanship and use of faulty formwork.

iii. **Use of Substandard Materials**: Hall (1984) posited that the use of low-quality materials is one of the major causes of structural failure. In their study, Aniekwu and Orie (2006) also identified low quality materials as the most important causes of failure of engineering facilities in Nigeria.

iv. **Absence of Building/Planning Permit**: Some building owners will just start construction work without approved drawing from development authority or in some cases even without drawing at all. Dimuna (2010) added that when drawings are not vetted by qualified professionals or relevant authorities before the buildings are erected, such constructions are based on guess work.

v. **Use of Non-Professional**: A cursory look at the building industry in Nigeria today reveals a preponderance of individuals who are ill equipped to carry out functions associated with construction (Dimuna, 2010). Nowadays, professionals in the industry due through pretence for selfish gains assume the functions of other professionals even where they lack competence. They very often deceive the clients to take over the functions of other professionals.

vi. **Use of Acidic and Salty Water**: Some riverine areas like Cross River, Bayelsa, Ondo, A/Ibom, Lagos etc. whose major sources of water is either from the oceans and seas often time have their water contaminated as result of oil and gas activities. Chemicals from such sources can react with construction material like cement, reinforcement bar, sand etc and eventually affect the strength of the structure.

vii. **Lack of Proper Supervision and Monitoring of construction work**: Dimuna, (2010) posited that even where a structural design is not deficient, absence of proper supervision on the site by qualified personal can led to building failure. Monitoring and evaluation of construction work in progress is paramount to ensure that as designed is as built.

viii. **Illegal Conversion/Alteration to Existing structures**: Some building owner as time progresses alter the functionality of the existing structure (residential to commercial) either by minimal alteration or outright addition of floor(s) against the original design approved by development authority. For example, block of two-storey building converted to three or more storey building without obtaining an approval from development authority and supervision by relevant professional.

ix. **Clients Penchant to Cut Corners**: Dimuna, (2010) stated that most building collapse are residential buildings owned by private individuals. Very often, due process is not followed in taking decisions concerning the construction. Madu (2005) posits that most Nigerian Client have a penchant for cutting corners by not employing qualified personal to produce the contract documents and supervise the building while during construction, they want to spend minimum amount of money on the construction.

x. **Foundation Failure**: Causes of foundation failure could be due to faulty structural design, improper soil test, wrong recommendation or designs of suitable foundation; substandard reinforcement bars etc or even a combination of some of them. This can only be avoided when soil investigation is appropriately carried out.

4. Reseach Methodology

This research work analysed the opinion of construction professionals with regards to the causes, effects and possible solution to the menace of collapse of building in Nigeria. Questionnaires were therefore sent to some selected respondents with vast experience in building construction management and with in-depth knowledge on the menace of collapse of building in Nigeria. Information about the registered professional was obtained from the Cooperate Affair Commission in Abuja. The registered professionals are Builder, Architect, Quantity Surveyor, and Structural Engineer respectively.

5. Data Collection Technique

The questionnaire uses a five-point Likert scale to measure a range of opinions from construction professionals (Architect, Structural Engineer, Builder, Quantity Surveyor, and Services Engineer) on the causes, effects and possible solution to the menace of building collapse in Abuja, Nigeria. Relative Importance index (RII) method was used in analysing the opinion of the construction professional within Abuja FCT. The Mathematical formula for RII is as follow:

$$RII = \frac{\Sigma W}{A \times N}$$

Where w is the weighting given to each factor by the respondents and a numerical scale of 5 for highest and 1 for lowest; where 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often 5 = Always and N = total number of respondents (81)

6. Sample Size

The sample size which represents the targeted unknown population was computed from the equation below;

$$n = \frac{N}{1+Ne^2}$$

where n is the sample size or number of samples, N is the Total population target and

e is the acceptable sampling error or error tolerance

For this research, the 95% degree confidence level corresponds to e =0.05. The population target was chosen to be (N) 160 samples. Therefore, the sample size can be calculated as follow;

$$n = \frac{160}{1+(160*0.05^2)}$$

$$= 114.29$$

The sample size is rounded thus 114.

7. Techniques of Data Analysis

Descriptive method of analysis that comprises of tables and charts was used to compute the relative ranking of those factors that causes building collapse, effects and possible solution. The results obtained were transformed to relative important indices based on the Likert Scale, to determine the relative ranking of the factors.

$$RII = \sum Nx \frac{5n5+4n4+3n3+2n2+1n1}{5[n5+n4+n3+n2+n1]}$$

Where Nx = the number of respondent agreeing with the x choice. Thus;

N1 = number of respondents for "Never", N2 = number of respondents for "Rarely"

N3 = number of respondents for "Sometimes", N4 = number of respondents for "Often"

N5 = number of respondents for "Always".

8. Analysis and Discussion of Findings

8.1 Respondent Profile

Questionnaires were administered to 114 respondents of various professions, with 106 being male and 8 females. As depicted by the bar chart below, Architect that represents 25.92% top the list of representation, followed by Builder with 23.46%, followed by Structural engineer 16.05%, Quantity survey with 20.99% and Services engineers 13.58%. The bar chart below depicts the distribution of respondents based on their profession.

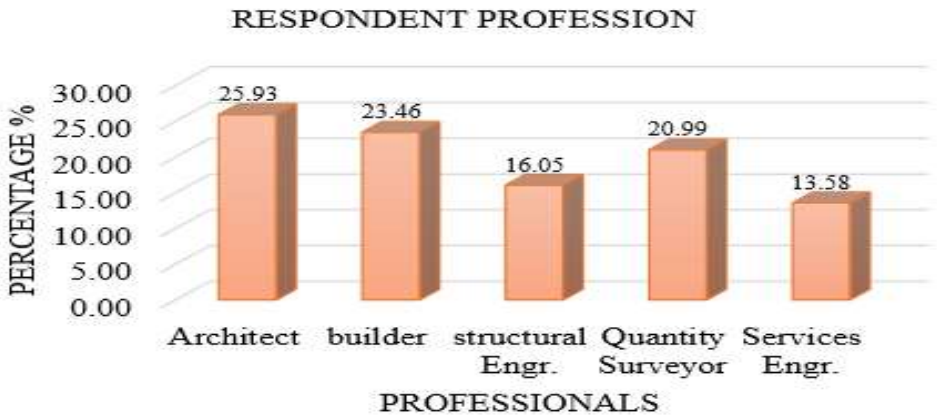

Figure1: Distribution of Questionnaires to Respondents by Profession

From the total 114 questionnaires distributed to the respondents, 89 were collected back. However, only the 81 questionnaires properly filled and as such fit to be used for the analysis. From the profile of the usable questionnaire, 41 of the respondents have been in the construction industry for 15yrs, 32 respondents have been engaged in the construction work for 25yrs and 8 respondents for over 30yrs.

8.2 Data Analysis and Discussion of Findings

Table 3 below reveals the responses of the respondent to what degree the various factors influence the collapse of building in the study area.

Table 3: Ranking of Factors Influencing Collapse of Building

S/N	Factors Influencing Collapse of Building	No. Of Respondents In Ordinance Scale					Total	Relative Index (RII)	Rank
		5	4	3	2	1			
1	Defective design	28	31	3	14	5	81	0.76	3
2	Defective construction	45	16	10	3	7	81	0.82	1
3	Use of Substandard Materials	17	43	6	13	2	81	0.75	4
4	Absence of Building/Planning	16	34	19	10	2	81	0.73	6
5	Non-Adherence to Approved building Plans	23	20	15	18	5	81	0.69	10
6	Improper Site & Soil Investigation	18	29	13	20	1	81	0.71	8
7	Engagement of incompetent contractor	40	16	13	9	3	81	0.80	2
8	Lack of supervision & monitoring of construction work	19	35	10	9	8	81	0.72	7
9	Illegal conversion, alteration & addition to existing structures	35	4	11	16	15	81	0.67	12
10	Fire outbreak	20	15	19	17	10	81	0.64	14
11	Natural disaster	12	33	14	11	11	81	0.66	13
12	Poor maintenance culture	25	11	22	19	4	81	0.68	11
13	Undue interference of client	20	27	12	18	4	81	0.70	9
14	People stay in condemned building	13	27	6	22	13	81	0.61	15
15	Use of non-professional	41	10	7	9	14	81	0.74	5

Source: Field survey, 2022

From this Table 3 above, the major Factor Influencing Collapse of Building in Abuja FCT is Defective construction with an overall RI score of 0.82 (rank 1). It is also evident from the table that Engagement of incompetent contractor with an RI score of 0.80 higher (rank of 2) than Defective design with an overall RI score of 0.76 (rank of 3). This followed by Use of substandard materials with an RI score of 0.75 (rank 4). The Use of non-professional has an RI score of 0.74 ranked 5 while Absence of building/planning permit, Lack of supervision & monitoring of construction work, Improper site & soil investigation, Undue interference of client, Non-Adherence to approved building plans, Poor maintenance culture, Illegal conversion, alteration & addition to existing structures, Natural disaster, Fire outbreak and People stay in condemned building were ranked lowest with an RI score of 0.73, 0.72, 0.71, 0.70, 0.69, 0.68, 0.67, 0.66, 0.64, and 0.61 (ranked 6, 7, 8, 9, 10, 11, 12, 13, 14 & 15) respectively.

Table 4 reveals to the ranking by the respondents the effects created when a building collapses in the study area.

Table 4: Ranking of Effects of Collapse of Building

S/N	Effect of Collapse of Building	No. Of Respondents In Ordinance Scale					Total	Relative Index (RII)	Rank
		5	4	3	2	1			
1	Leads to injury, loss of live & property	16	39	10	10	6	81	0.80	1
2	Bring about unforgettable trauma	19	27	18	11	6	81	0.70	5
3	Causes insecurity	26	9	31	13	2	81	0.71	4
4	Social economic development	12	16	24	9	20	81	0.58	9
5	Increase budget for house construction	41	17	6	13	4	81	0.79	2
6	Loss of capital to the contractor	32	8	15	12	14	81	0.68	6
7	Withdrawal of professional licenses	36	23	11	1	10	81	0.78	3
8	Destruction of our Ecosystem	23	13	25	8	12	81	0.67	7
9	Negative impact to the adjoining buildings	3	32	23	16	7	81	0.62	8

Source: Field survey, 2022

From Table 4 above, from the perspective the respondent view shows injury, loss of live & property with an overall RI score of 0.80 ranked the highest (1) effect collapsed building has produced in Nigerian construction industry. This is closely followed by increase in budget for house construction, withdrawal of professional licenses, insecurity, unforgettable trauma, with RI scores of 0.79, 0.78, 0.71, 0.70 (rank 2, 3, 4 & 5) respectively. The respondent considered the other effects like loss of capital to the contractor, destruction of our ecosystem, negative impact to the adjoining buildings and social economic development with RI scores of 0.68, 0.67, 0.62 & 0.58 (ranked 6, 7, 8, 9 & 9) respectively of less importance when it comes to the issue of effects of Collapse of Building.

Table 5 below ranks the remedies to collapse building. The ranking by the various respondents are as tabulated.

Table 5: Ranking of Remedies to Collapse of Building

S/N	Possible remedies to causes of building collapse	No. Of Respondents In Ordinance Scale					Total	Relative Index (RII)	Rank
		5	4	3	2	1			
1	Avoid engagement of quacks	41	28	3	8	1	81	0.85	2
2	Compliance to design specification	23	35	11	8	4	81	0.76	6
3	Use of high-quality building materials	49	11	18	3	0	81	0.86	1
4	Constant supervision & monitoring	20	34	18	5	4	81	0.75	7
5	Proper soil Geotechnical investigation	37	21	8	10	5	81	0.79	3
6	Engagement of right professional	28	18	31	3	1	81	0.77	5
7	Effective maintenance culture	12	43	13	11	2	81	0.73	8
8	A well reputable/competent contractor	29	24	19	9	0	81	0.78	4
9	Seek building/planning permit from development authority	31	14	26	10	0	81	0.57	9

Source: Field survey, 2022

Table 5 above indicates that Use of high-quality building materials ranks 1st, with an overall RI score of 0.86 as the most effective possible remedies to collapse of building in Nigeria. This is followed by avoid engagement of quacks with an RI score of 0.85 (ranked 2nd) and proper soil geotechnical investigation with an RI score of 0.79 (ranked 3rd). The other possible remedies all rank below 0.78 which indicates low frequency.

9. Summary of Findings

The information obtained and analysed from questionnaire had categorically express the opinion of building professional toward the causes, effects and possible solution to building collapse in Nigeria. Results obtained from Table 1 shows that defective construction is the main factor causing building collapse followed by engagement of incompetent contractor. This research work believes that when defective construction is eliminated, all other factors mentioned could be reduced to minimal. Furthermore, Table 2 shows that injury, loss of live & property ranked 1st. This shows that whenever there is case of building collapse it could either result to the loss of life of the occupants and/or property will be damaged/destroyed which will require additional fund to manage the situation. Table 3 reveals the possible solution the menace of collapse of building. Use of high-quality building materials with overall RII 0.86 ranked 1st and the lowest is Seek building/planning permit from development authority with RII 0.57 ranked 9th amongst the possible solution to the menace of building collapse. When all these suggestions mentioned were put to practice, the menace of building collapse could be minimized if not eliminated.

10. Conclusion

This research work has looked into cases of building collapse in Nigeria. Essentially, it investigates the causes, effects and possible remedies to building collapse in Nigeria. The menace of building collapse in Nigeria will keep on occurring until the Development Authority and other professionals in building industry work together to enforce the planning law. This study has been able to establish that the menace in Nigeria is as a result of unethical practice of some professional and stakeholders. It should be stated that the present laws and codes are enough to overcome these challenges, but these are often adhered to in breach than in observance.

11. Recommendations

Base on the research findings, the following recommendations were given.

i. Much attention should be placed on the major Factors Influencing Collapse of Building in order to prevent the future menace of the cases.
ii. Building Contractors should be encourage to Use high quality building materials during construction stage so that high quality work can be guarantee with reduction of waste and unforeseen conditions.
iii. Contracting firms should engage the services of professional builder and upgrading of staff's professional skills through regular training, refresher courses and participation in seminars.
iv. The National building code in national assembly should be passed into law as it contained, will regulate building industry ensure better performance and tremendous kick against collapse of building in Nigeria.
v. Government agency like Standard Organization of Nigeria (SON) should ensure that only duly certified and quality construction materials are allowed into the market.

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