

## DESIGN AND CONSTRUCTION SUPERVISION AS STRUCTURALLY SUSTAINABLE TOOLS FOR BUILDING FAILURE/COLLAPSE IN NIGERIA

**OJO I. Clement,**

*Department of Architectural Technology  
Rufus Giwa Polytechnic, Owo  
[ojoidclem@yahoo.com](mailto:ojoidclem@yahoo.com)*

**OLABINTAN, O .Dele**

*Department of Architectural Technology  
Rufus Giwa Polytechnic, Owo  
[bintanod@yahoo.com](mailto:bintanod@yahoo.com)*

### ABSTRACT

The persistent occurrence of buildings collapse in Nigeria, demands for urgent interception, and curtailment for immediate upliftment of structural standard. This paper presents design and supervision processes as a means of structural fortification for prevention of building collapse. It examines records of some reported building failures/collapses in Nigeria, structural defects in some selected roofs and the extent of professional involvement in their design and construction. It also identifies those factors responsible for the failure of building design and construction supervision process and recommends solutions to them since their continuity may result to serious structural instability. The paper concludes that structural sustainability can be greatly improved upon through design and construction supervision by depending on highly skilled professionals with intention to minimize potential ambiguity, disputes, and fraud and building collapses/failures. Finally, it recommends the integration of quality assurance committee to monitor structural quality and ensure adherent to building codes and regulations.

Keywords: Buildings Collapse, design, construction, supervision, structural sustainability

### INTRODUCTION

**OJO K. Francis**

*Department of Architectural Technology  
Rufus Giwa Polytechnic, Owo  
[kehindeojo69@yahoo.com](mailto:kehindeojo69@yahoo.com)*

**SALAMI, R. Olugbenga**

*Department of Architectural Technology  
Rufus Giwa Polytechnic, Owo  
[salamraf@yahoo.com](mailto:salamraf@yahoo.com)*

### INTRODUCTION

The development of building construction from simple homes to complex modern structures has not only allowed standardization of materials, affordable and workable methodology of construction and product, but also enhance a highly organized industry with professionals having area of specialization generating large volume of economic activities. In Nigeria, construction has extensively stimulates growth in other sectors of the economy and provides direct employment opportunities for the populace (Ede, 2011). The industry accounted for an average of 35% of total fixed capital formation of current purchase value and 30% of the total registered employment between 1960 and 1970 (Adeniyi, 1985) as cited by Jinadu (2004) and in most developing countries major construction activities account for about 8% of the total capital asset (UNCHS, 1996). Despite the viability of this cherish industry, it is experiencing some set backs and one of the debacles and bane of this dynamic economic inducement is the danger of structural instability and failures pose by some buildings under construction and others already completed and in use leading to sudden collapse and resulting in heavy devastation with resultant loss of properties and many ultimately deaths.

In order to stop these anomalies, various researches had been carried out but the situation still remains uncontrollable. From historical data, the incidence of structural failure or building collapse record started in 1974 but has been on the increase from 1985 till date as presented in table 1. Though much had been accomplished towards its reduction but little or no result of improvement had been observed and under such situation it was either the causes had not been identified or stakeholders remain indifference to suggested solution (Ede, 2011).

Through practice and field studies, possible causes of failure can be traced to the activities that take place in the following stages of a building process: conception-design stage, construction-supervision and post construction-service stage, (Ayininuola and Olalusi, 2004). This paper considers how building design and construction supervision can be a potent weapon in the hands of professionals to drastically reduced building collapses and structural failures.

## **AIM AND OBJECTIVES**

### **Aim**

This paper uses data of published materials in explaining building design and construction supervision processes as structurally sustainable tools in preventing building failures/ collapses in Nigeria.

### **Objectives**

- The use of architectural and engineering structural designs for structurally sustainability in buildings.
- The involvement of professionals in all aspects of building design and construction supervision processes.

## **METHODOLOGY**

The study uses secondary data of some reported collapsed buildings in Nigeria (1974-2010), text books, academic journals, conference proceedings,

dissertations, thesis and related web sites. The research collects and considers together from the publications facts and data on designs (architectural and structural) and construction supervision for consolidation and sustenance of the present distressed structural system.

## **LITERATURE REVIEW**

Arayela and Adam (1980) observed that defects may have their inception in inadequate briefing or design deficiencies may culminated in problems such as: design bearing support, calculation errors, deformation shrinkage, errors in assumed loading, changes in existing structures. Again difficulties in construction could be arise as a result of inadequate overall field inspection, poor mixing and placing practices, handling and erection especially with lift slab work and precast units. Others are overloading either vertically or laterally, unstable bearing support for form work, premature removal of formwork, insufficient cover for reinforcement or unsatisfactory quality of reinforcing materials. It was therefore concluded that adequate attention should be paid to these factors during design and construction stages.

The client's parameters are design control for architects, quantity surveyor and engineers who are employed by him to protect his lack of technical knowledge so that he may be provided with building that will be suitable for his purpose, and also designed in light of legal restrictions, reasonably conceived in terms of present days technology and within his financial capability.

According to Groffin (1990) as cited by Adegbamigbe [2003] he categorized the obstacles surrounding the achievement of sound building broadly into two; design and construction. Those of design are itemized as inaccurate or inadequate

detailing of designed concepts, incorrect specifications, misusing of materials and components, inadequate knowledge or disregard to legislations or advisory documentations, poor communication between client and designer or between consultants and contractors. He also listed construction inadequacies as poor supervision of construction by consultants, build ability speed and cost factors outweighing the requirement for quality workmanship. Others are inadequate definition of site duties to the workforce, yardstick of performance are not prescribed, poor information flow, few quality and control procedure used at site level, inadequate skilled and motivated operatives, and lack of team work and direction. Groffin concluded that the utilization of quality assurance in the construction process will provide the client with the product that will be suitable for his intended purpose.

About 33% of land area of Nigeria lies in tropical forest and characterized with high rainfall, many rivers overflowing their banks, increase in moisture content of the soil and high groundwater level. The soil in Warri for instance contains a mixture of sand wet and marshy that it loses its bearing capacity and the building in such ground are vulnerable to sinking. For sustainability of buildings on such ground, the soil is firstly examined to determine the type, depth of humus, the load bearing capacity and the stress unit (Izomo, 2001) He concluded that the correct type and size of foundation can be designed and supervised to offset the problem of differential settlement and this can be successfully carried out to approved standard of structural sustainability and client satisfaction by professional engineers.

In similar a report, over 5000 farmlands was washed away by ravaging flood across the country. About six houses were carried away at the confluence city

of Lokoja in Kogi State while some houses were also submerged in Anambra State (NEMA,2012).

#### **SOME CAUSES OF FALIURE IN BUILDING DESIGN AND CONSTRUCTION SUPERVISION PROCESS,**

The informal sectors of construction can be identified as firms and individuals who engage in construction without consulting the planning office or obtaining the necessary building plans approval with other documents backing up the authenticity of their operations. These sets of people usually evade the formal procedure of obtaining approval permits for construction and its related activities and this unethical practice with its peculiarity constitutes menace to structural sustainability and development. The operations are mostly featured in rural areas and urban outskirts.

In Folagbade and Olawumi (2010), out of 25 contractors in each of the six geographical regions of Nigeria 68.6% evaded approval and in a similar questionnaires administered for clients, 75% of them also evaded plans approval before commencement of their construction work. These two observations revealed the degree of structural failures the informal sectors are creating and the enormous damages been caused which can only be minimized if adequate preventive measure is implored.

The analysis of some of the reported cases of collapsed buildings in Nigeria 1974 – 2010 was considered with reference to those constructed by private, public and corporate organizations. Failure was observed to be more pronounced (70%) in those constructed by private organization while those of public and corporate organizations were 23.3% and 6.7% respectively. The reason for the high percentage in private sector was not unconnected to the hasty and care free manners in which private clients handle their buildings.

Corruption can be compared to cancer; in the building industry, corruption is a major cankerworm devouring the fabric of the industry like any other sphere of Nigerian society. Contractors may be so fraudulent in lowering the standard of work contrary to Bill of Quantities and this craftiness is mostly manifested and perfected in public work where reduction can be manipulated in concrete slabs, foundation footings, beam sizes, reinforcement thicknesses and spacing number of paints' coat, gauge of roofing and asbestos sheets and quality of mortar and concrete. This could only be detected by curious consultants if only they have not colluded with the perpetrators (Adegbamigbe, 2003).

The issue of eradicating corruption from the society should be pursued by individuals, government and Non Governmental organizations and the society should be educated that involvement in corruption is just mortgaging our future for the oppressors and giving room for failure in our social, political and economic system. All should join hands together to rid the building industry of corruption most especially in the building design and construction supervision stages while offenders should be punished and no sacred cow should be spared. The due process in the award of contract and project execution recently introduced by the Federal government of Nigeria is a positive step towards eradication of corruption and the "10% syndrome" in the construction industry (Olabintan 2012).

**TABLE 1: Some Of The Reported Cases Of Collapsed Building In Nigeria (1974-2010)**

S/ N	TYPE OF BUILDING STRUCTURE	LOCATION OF BUILDING	DATE OF COLLAPSE	SUPECTED CAUSE(S)/DEFECTS	REMARKS (LIVES LOST)
1	Multi-storey Building under construction	Mokola, Ibadan, Oyo State.	October 1974	Excessive Loading/Structural failure.	27 people
2	Partial collapse	O.A.U. Ile-Ife.	1976(1975/76)	Structural Failure	Nil.

	of a Hotel Building		Academic Session.		
3	Residential Building	Bar nawa Housing Estate, Kaduna.	August 1977	Faulty Design.	28 People.
4	School Building	Government Secondary School, Makarfi, Kaduna State	July, 1977.	Carelessness.	7 People.
5	3-Storey Residential Building	Bar nawa Housing Estate, Kaduna	1980	Faulty Structural Design	6 people.
6	Storey Residential Building	Allen venue, Ikeja Lagos State.	January, 1985.	Excessive Loading.	Nil
7	Residential Building	Adeniji Adele, Lagos State	February, 1985.	Excessive Loading.	2 people
8	Residential Building.	Ojuelegba Area, Lagos.	May 18, 1985.	Rainstorm	Nil
9	Residential Building (Uncompleted four-storey Building).	Iponri, Lagos	May 20, 1985.	Structural failure.	13 People.
10	Residential Building	Victoria Island, Lagos.	July 18, 1985	Excessive Loading	13 People (all of the same family).
11	Residential Building	Gboko, Benue State.	September, 1985.	Carelessness.	1 People.
12	Residential Building	Allen Avenue	1985	Carelessness.	Nil.
13	Residential Building	Adeniji Adele, Lagos.	1985	Faulty design/ Carelessness	2 people
14	High Court Building	Isala Area, Imo State.	February, 1986.	Structural Failure.	2People
15	Mosque Building	Oshogbo, Osun State.	May, 1986.	Structural Failure	2 People.
16	Residential Building	Ona Street Enugu, Enugu State.	1986	No Investigation.	2 People.
17	2-Storey Building Under construction	Agege, Lagos.	May 9, 1987	Structural Fault.	2 People
18	Residential Building	Idusagbe Lane, Idumota, Lagos	September 14, 1987.	No Structural Design.	17 people.
19	Commercial Building	Ikorodu Road, Lagos	September, 1999	Rainstorm.	4 People.
20	Residential Building	Calabar, Cross River State.	October 9, 1987.	Rainstorm.	3 People.
21	6-Storey Hotel Building	Akinwunmi Street, Mende Village, Lagos.	October, 1989.	Faulty Design.	Nil
22	Bungalow School Building	Port Harcourt, River State.	June 15, 1990.	Ignorance of the owner and absence of Structural Design.	Nil
23	Multi-Storey Building NICON-NOGA Staff Housing Project.	Karo, Abuja.	March 25, 1993.	Structural Failure/Use of Incompetent People for Supervision.	Not Reported.
24	Multi-Purpose Indoor Sports Complex Storey.	Area 10, Abuja.	March, 1993.	Structural failure/Poor Workmanship.	Not Reported.
25	A Mosque Building Under Construction	Abeokuta gun State.	1995	Structural failure/Use of Incompetent People for Supervision.	2 people
26	Storey Building Under Construction)	Central Lagos.	October 5, 1995.	Poor Workmanship/Structural Failure.	10 People
27	3- Storey Church	Lagos.	October, 30, 1995.	Structural failure	6 people

	Building				
28	School Building	Alagbado Area, Ibadan, Oyo State.	October, 1995	Poor Workmanship/Structural failure	Nil
29	3-Storey Building	Oke Igbala Area, Ibadan, Oyo State.	October, 1995	Structural failure	6 People
30	Storey Building under construction	Lagos State	March 13, 1996	Structural failure	People only injured
31	1-storey building under construction but being used as church (Earlier approved as a bungalow)	Olowookere Street, Mafoluku, Oshodi, Lagos	June 1996	Structural weakness	7 people
32	6-Storey Building Under Construction (being used as Nursery/Primary School)	Lagos State	October 1996	Use of quacks/Structural failure	1 Person
33	2-Storey Building	Amu Street, Mushin, Lagos State	June, 1997.	Use of Poor materials/Structural Failure.	Nil
34	Duplex Building	Gwarinpa Area, FCT, Abuja	1998	Structural failure	2 people
35	3-Storey Residential Building	Ibadan, Oyo State.	1998	Faulty Design/Poor Workmanship.	Several People.
36	4-Storey Church Building (Under Construction)	Akure, Ondo Stat.	October 1, 1998	Structural Failure /Poor Supervision	8 People.
37	2-Storey Residential Building	Rd,3 Plot 10, Funbi Fagun Street, Abeokuta, Ogun State.	November, 1998	Use of Poor materials/Structural failure	Nil
38	3-Storey Residential Building	Ojuelegba, Western Avenue, Surulere, Lagos State.	1999	Carelessness/Use of poor materials	4 People
39	A Storey Residential Building	Adeola Odeku Street, Victoria Island, Lagos.	1999	Rainstorm	Not reported
40	3-Storey Residential Building	Charity road, Oko Oba, Lagos.	June, 1999	Structural failure	Nil
41	3-Storey Residential Building	Four-Square Gospel Church, Abuja.	October, 1999	Faulty Design/Implementation	Not Available
42	A Storey Residential Building	Obawole Street, Iju Agege, Lagos.	October, 1999	Structural Failure	Nil
43	3-Storey Residential Building	Iju-Isaga, Lagos	August, 1999	Structural Faulty/Rainstorm	35 People
44	2-Storey Residential Building	Dawodu Street, Ifo, Ogun State	October, 1999	Rainstorm	20 People
45	Residential Storey Building	Idi-Oro, Mushin, Lagos	2000	Faulty Design/Carelessness	Not Available
46	Estate Building	Ajah, Along Lekki Road, Lagos	April, 2000	Structural Failure	Nil
47	2-Storey Mosque Building	21, Buhari Street Mushin, Lagos	April, 2001	Unauthorized Conversion of former Bungalow to 2-Storey Building	7 People
48	A Storey Residential Building (Under Construction)	Iwoye-Ijesa, Osun State	2001	Structural Failure/Use of quacks for supervision	7 People
49	Multi-Storey Commercial Residential Building	Ebute-Meta, Lagos	2007	Unauthorized conversion/Poor Supervision/Use of quality materials	Several People
50	Multi-Storey Building	Kano	2007	Faulty Design/Structural Failure	Several People

51	A Building being used as Nursery/Primary School	Olomi Area Ibadan, Oyo State.	March 25, 2008	Use of Poor Materials Carelessness	13 Pupils
52	5-Storey Shopping Complex Building Under Construction	Wuse Area, Abuja	August 2, 2008	Use of Poor Materials Carelessness	13 Pupils
53	2-Storey Residential Building (Under Construction)	Asero Area, Abeokuta Ogun State	August 30, 2008	Contravening the given Planning Approval, Use of Substandard Materials Incompetency, etc.	2 People
54	6-Storey LAUTECH Teaching Hospital Complex under Construction	Ogbomoso, Oyo State	February 19, 2009	Use of Substandard Materials, Poor Workmanship/Supervision	5 People
55	A wall fence	Aghaji Crescent, GRA, Enugu	August 10, 2010	No Proper Drainage	1 Person
56	Uncompleted Building	Oke Padre Street, Itamorin, Abeokuta	October 18, 2009.	Use of Substandard Materials hasty Construction	3 People, 11 Injured
57	Building Under Construction	Isopakodowo Street Cairo, Lagos.	April 26, 2010	Use of Substandard Building Materials.	4 People, 12 Injured

Source: Published by Canadian Center of Science and Education cited by Fagbenle and Oluwunmi Dec. 2010.

**Table 2.0: Analyses Of Structural Defects In Collapse Buildings In Nigeria 1974-2010**

S/N	DEFECTS	FREQUENCY	PERCENTAGE (%)	RANKING
1	Design/Structural Design Failure (DSF)	11	12.79	3rd
2	Disregard to Code/Regulation (DCR)	5	5.81	7th
3	Hasty/Carelessness (HC)	8	9.80	5th
4	Rainstorm (RS)	6	6.97	6th
5	Substandard Materials (SM)	11	12.79	3rd
6	Structural Problems Construction Methodology Overloading (SCMO)	31	36.04	1st
7	Workmanship/Incompetent Supervision	14	16.24	2nd

Source: As Deduced from the Published Canadian Center of Science and Education Cited by Fagbenle and Oluwunmi Dec. 2010.

**DATA ANALYSIS AND INTERPRETATION**

From Table 2.0, Structural problems, Construction methodology and Overloading (SCMO) were ranked first with 36.04%, workmanship/incompetent supervision was ranked second with 16.2%. One of the objectives of achieving structural sustainability in this paper is readiness of continuous usage professionals in all stages of design and construction process. The high level of workmanship/Incompetent supervision was one of the factors that is highly responsible for poor structural sustainability. Except rainstorm (6.97%) which could be subject of natural disaster, the remaining structural defects/failures are feature of neglect of professionals' participation and they could be tackled by continuous involvement of professionals in all aspects of building design and construction from conception to design construction and maintenance stages. Therefore Nigerians should be educated on the use of professionals in all these stages and the consequences of shoddily designed and supervised structures be made known to them through media.

**Table 3: Failures and Months of Highest Occurrences 1970-2010**

S/N	YEARS	FREQUENCY	MONTHS OF HIGHEST OCCURENCE
1	1970-1975	1	October with one time.
2	1976-1980	4	January with one time
3	1981-1985	8	May with two times.
4	1986-1990	9	October with two times
5	1991-1995	8	October with four times
6	1996-2000	17	October with five times
7	2001-2005	2	April with one time
8	2006-2010	12	August with four times.

Source: As Deduced from the Published Canadian Center of Science and Education Cited by Fagbenle and Oluwunmi Dec. 2010 in Table 1 above.

From the Table 3.0,the highest occurrences of structural failures were realized between 1986-

1990,1991-1995 and 1996-2000 in October with 2,4 and 5 times respectively. In agreement with this assertion, Olabintan (2006) concluded that rainstorm damage to buildings is caused primarily by the effects of the prevailing wind and the locally generated wind occurring mainly at the beginning of rainy seasons – (mid-February to May) and towards the end of rainy seasons – (September to October).One of the defects affecting structures at this period which related to weather condition was rainstorm. For better understanding of structural defects and sustainability professionals are advised to visit sites more frequently in October for intensive observations and experimentations in discovering the causes and proffer solutions in preventing future structural deficiencies.

**Table4: Professional Involvement In Roof Design And Construction Of Selected Structures In Nigeria**

Source: Jolaoso, 2006

PROFESSIONALS	DESIGN		CONSTRUCTION		TOTAL INVOLVEMENT OF PROFESSIONAL		TOTAL WITHOUT OF PROFESSIONAL INVOLVEMENT	
	NO	%	NO	%	NO	%	NO	%
Architect	3	20	1	6.67	4	26.7	11	73.3
Structural Engineer	2	13	1	6.67	3	20.0	12	80.0
Builder	-	-	1	6.67	1	6.67	14	93.3
Quantity Surveyor	1	6.67	1	6.67	2	13.4	13	86.7
Technical/Draftsman	7	46	3	20.0	10	66.7	5	33.3
Artisan/Craftsman	4	26	9	60.0	13	86.7	2	13.3
Building inspector from planning regulatory office	-	-	0	0.00	0.00	0.00	15	100

The above table shows the involvement of professionals in design and construction of the roof of some selected structures in Abeokuta. According to Jolaoso 86.0%, 66.7%, 26.7% and 20% of Artisan/Craftsman, Technician/draftsman, architects and structural Engineer were respectively involved. It is clear that most of the design and construction were implemented by artisan/craftsman and technician and draftsman which lack professional knowledge of design, and the followed up supervision during construction and again there was no record of any regulatory agency that oversee the projects hence, those buildings were prone to suffer failures. The reported alarming rates of occurrence of collapse and blown off roofs due to wind and rain storm are really disturbing and creating great concerns in Nigeria (Mogbo 1998a). Hence, professional expertise is not only needed in roof design and construction alone but also for the consolidation of the whole building structure while activities of regulatory agency be updated and reactivated to perform their required responsibilities of structural sustainability.

#### **CONSULTANTS AND BUILDING DESIGN**

Architectural design in a broad sense is a phenomenon of re-shaping and re-furbishing of physical environment to meet biological, material, spiritual and physical needs of man with pre-occupation of satisfying the threefold challenge of function, aesthetic and structural stability. At conception (design stage) the architect begins planning, feasibility studies and the design of building with critical evaluation of technical and economic values for realization of desired form. After this stage, it requires the input of other professionals in the building industry including

structural engineers, to design the structure for buildability and stability. A British Establishment discovered that out of 510 defects 58% could be attributed to engineering or Architectural faults (Adegbamigbe, 2003). Hence the holistic of design consists of creation of architectural forms, the detail drawings, identification of load, selection of materials and apportioning of action so that the basic requirement of safety, aesthetic, economy and construction stability are considered irrespective of the client's brief. (Davison and Owen, 2003)

Other requirements include investigation and determination of soil type through soil tests, establishment of ground water table and drainage to determine foundation type and design. The designer ensures that the structures are stable and also guarantee the safety of occupants and any failure emanating from structural defects and design failure may attract litigations which in many situations may lead to heavy compensations for damages on part of designer (Agbo, Agbonna and Okwoli, 2004). Therefore, he must carry out his duty with all diligence and care and be sincere enough to take projects that match his professional skill and experience and also operate under the building regulations and code.

#### **CONSULTANTS AND CONSTRUCTION SUPERVISION PROCESS**

Construction supervision by consultants is the physical realization stage of overseeing the structure to be in agreement with the conceived design. It is the summation of all observations and actions taking on site that ensure building erection conforms to design and specification as various sub-stages of construction process are inspected. This stage involves numerous and complex activities that only well trained professionals can handle (Ede, 2010).A

high level of skill is needed in both designing and construction supervision for realization of quality job (Ayininuola and Okaloosa, 2004). The tools that will enable consultants to realize these objectives are their professional experience in relevant specialized fields, available research, materials, government regulations and codes which are neither possessed nor obeyed by artisan/craftsman, technician/draftsman and other quacks. As posited by Adebayo (2000), the skill, experience and personal ability of the workmen involved in construction (supervision) is utmost importance in creating value, hence architects, engineers, quantity surveyors etc are bound to possess reasonable amount of skill in their profession for reward and to be diligent and careful enough in carrying out their duties. Lack of care or skill in dealing with clients or affected person by their action might lead to error, and be regarded as negligence or omission in performing their agreed responsibilities (Uri and Kparevzua, 2004). Building professionals, consultants call for more caution, diligent and skill in avoiding foreseeable injury or incurred loss from instituted legal action against them for damage suffer by their clients. To ensure value for money and result oriented project execution, Olabintan, (2012) reiterated that developers in both private and public sectors and Governments at all levels should ensure that qualified and experienced professionals are employed. This he said will reduce the spate of quackery and the attendant problems such as project failures and even building collapse.

#### **SUMMARY**

From Table 2.0, it could be deduced that poor workmanship/incompetent supervision had about 16.24% and ranked second. The consequential effect had grossly affected and resulted in structural problems, poor construction methodology and

overloading that was ranked first with 36.04% defects. Table 4.0 had greatly expressed the effect of professional inadequacy in the roof construction because of high percentage participation of non-professionals. Table 3.0 shows a high frequency of building failure in October, however this can be the subject of further research.

#### **CONCLUSION**

This paper discussed the poor structural system in Nigerians' buildings and how design and construction supervision can be used to consolidate effective and efficient structural system. Formidable building structures can be established during construction process by utilization of high skilled professionals with high integrity and timely adoption of clients' comprehensive brief which maturation could progress to minimize potential ambiguity, disputes and fraud if intelligently managed. Again consultants and contractors should be scrutinized when securing contracts and such contract should compulsorily match their specialization, experience and skill.

For consolidation of the structural system, quality assurance committee should be inaugurated to monitor the contractors and also to confirm the enforcement of the building law and code as approved by relevant authorities.

#### **RECOMMENDATIONS**

- There should be comprehensive brief to guide design and construction phases and minimize potential ambiguity and disputes, and give way to excellent design which finally resulted to excellent building.

- Design needed to explained, defended to professional colleagues, consultants, planners and clients.
- Changes in either design or construction method or materials of construction should be made with due consideration as hurriedly made decision without the consideration of other factors is detrimental to the whole building because good design take long time before its conception is reached and changes made should be well- detailed for easy construction and supervision of the whole project.
- During the time of receiving information, designers may ran out of time or impatient but they should practice and perfect the culture of imbining discipline, well-organized, commitment to work without misunderstanding of information as any error may lead to misinterpretation which often lead to abandonment, increase in cost overrun and even resulted to protracted dispute which can end up in court.  
Designers should employ professionals colleagues in checking of their drawings as self-checking may be subject to error due to familiarity.
- Prior practical completion of buildings, inspection should be made by consultants team headed by architect and all defects should be corrected by contractors before the handing over of the project and after six months, a visitation of the building by the consultants is mandatory for the contractor to complete all inadequacies identified by them before they gradually deteriorate which may eventually lead to structural failure.
- Professional bodies should organize seminars, conferences and lectures for skill upgrading and continuous Professional Development of members and materials development for compatibility. Trained professionals in building industry should be encouraged to register as illegal operation give room to infiltration of their profession by quacks.
- Consultants should be appointed as quality assurance team to monitor the design and construction of projects.
- Professional bodies in building industry should operate in their area of competence in order to reduce building collapse.
- Quality assurance institution should be inaugurated to monitor the consultants and the contractors for well-finished and quality projects outcome and also to see that the instituted building code, law and regulation are adequately enforced by the approving authority and monitoring team in the building industry.
- The consultants and the contractors that execute contract projects and come out with distinctive quality should be recognized commended and also be given consideration in future contract works. If they are given priority and highest interest, this will contribute to their continuous development, effectiveness and recognition which will eventually move them up for higher performance. If these contractors and consultants are yearly scrutinized and 70% of the contracts are yearly given to them and

some reputable nominated contractors, there will be competition in building up integrity while fraud and abandon projects and contract will be greatly checked out.

- There should be public enlightenment on the use of professionals in design and construction supervision.
- There is need to establish Material Testing Laboratory for testing soils, cement, concrete and other construction products. This will enhance carrying out integrity test for buildings.

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**ABOUT THE AUTHORS:**

**OLABINTAN O. Dele:** Is a Principal Lecturer in the Department of Architectural Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria

**OJO K. Francis:** Is a Principal Lecturer in the Department of Architectural Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria

**Ojo I. Clement:** Is a Senior Lecturer in the Department of Architectural Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria.

**SALAMI R. Olugbenga :** Is a Lecturer 11 in the Department of Architectural Technology, Rufus Giwa Polytechnic, Owo, Ondo State, Nigeria