Incessant Incidents of Building Collapse in Nigeria: A Challenge to Stakeholders

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***Abstract*-The paper examines the increasing incidences of building collapse in Nigeria. The paper attributes the rising incidents of building collapse to the use of substandard building materials and incompetent professionals in construction activities; the refusal of the wider society to recongnise professionalism and pay for the services and the attitude of the building contractors and other stakeholders as the major problem. The paper asserts that promoting or achieving an enduring safety culture in building involves designing, constructing and using buildings, in such a manner as to make the building safe for occupation and for carrying out all desired activities. Strategies for ameliorating the trend are suggested. The paper posits that stakeholders in the building development have great roles to play to reduce and avert this trend.**

Keywords: Incessant, Building Collapse and Nigeria.

I. INTRODUCTION

The frequency of collapse of building structures in Nigeria in the past few years had become very alarming and worrisome. Many lives and properties have been lost in the collapse of buildings mostly in Port Harcourt, Abuja and Lagos. Many property owners have developed high blood pressure and some have been sent to an early grave. A visit to the collapsed scenes were as revealing as they were pathetic and one could not but wonder why such contraption could have been allowed to stand or to what extend people can go to cut corners at the expenses of respect for safety and respect for lives. Unfortunately, there are still a number of buildings of similar circumstances dotting the skyline of many cities in Nigeria.That building collapse incidence are still regularly occurring despite increasing diffusion of engineering knowledge over the years calls for some reexamination of developments in building production and control process. As observed by Adeniya in (2002) why must a preventable incidence continue to traumatize us all the time? These incidents have brought to question the effectiveness of building contractors in the country.The menace also casts a slur on the competence of the nation's building community of architects, structural engineers and builders – who are the professionals responsible for designing and monitoring construction works at building sites.These professionals are being attacked from all angles because of the recurring incidents of building collapse. But the building professionals should not bear the blame alone. This is because, firstly, it has been proved that owners of building under construction derail from their approved plans relying more on imagination and fantasy. Secondly, the approving authorities are also known to fail to monitor compliance with approved plans. Thirdly, some building owners shun professionals in order to cut costs. Fourthly, the high cost of building materials has led greedy contractors with eyes on profits, to patronize substandard materials. These short-cut measures have contributed immensely to the occurrence of failed buildings in the country.The paper will critically examine the reasons for building failures or collapse and types of failures. It will also examine the roles of stakeholders in building and construction industry and articulate strategies that would help to arrest these ugly occurrences.

II. THEOCRETICAL FRAMEWORK

One 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 etal 1989). Simply put, the purpose of structural design is the provision of a structure satisfying the client's and user's requirements. It must be economical, safe, serviceable and aesthetically adequate. Fundamentally, the design process consists of findings and detailing the most economical structure consistent with the safety and serviceability requirements. This should be the basic design concepts of any architect and structural engineer.Mosley et al (1985), posited that the design of an engineering structure must ensure that (1) under the worst loading the structure is safe. (2) During normal working conditions the deformation of the members does not detract from the appearance, durability or performance of the structure. Despite the difficulty in assessing the precise loading and variations in the strength of the concrete steel theses requirements have to be met. Three basic methods using factors of safety to achieve safe, workable structures have been developed for engineering designs; Mosley et al (1985) identified them as:The permissible stress method in which ultimate strengths of materials are divided by a factor of safety to provide design stresses which are usually within the elastic range.The load factor method in which the working loads are multiplied by a factor of safety.The limit state method which multiplies the working loads, by partial factors of safety and also divides the materials ultimate strength by further partial factors.The engineering code of practice (CP.110) is based on limit state principle. When a structure is rendered "unfit for use", it is

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said to have attained a limit state. The code listed the limit states as:

(a) Ultimate Limit State – Collapse

This requires that the structure must be able to withstand, with an adequate factor of safety against collapse, the loads for which it is designed. The possibility of building or overturning must also be taken into account, as must the possibility of accidental damage as caused, for example by an internal explosion.

(b) Serviceability Limits State – Deflection, Cracking And Vibration.

Deflection – the appearance or efficiency of any part of the structure must not be adversely affected by deflections.
Cracking – local damage due to cracking and spalling must not affect the appearance, efficiency or durability of the structure.Other limit states that may be reached include:
Durability – this must be considered in terms of the proposed life of the structure and its conditions of exposure.
Excessive Vibration – This may cause discomfort or alarm as well as damage.Fatigue – must be considered if cyclic loading is likely.Fire Resistance – this must be considered in terms of resistance to collapse, flame penetration and heat transfer.ViiSpecial Circumstance – any special requirement of the structure which is not covered by any of the more common limit state, such as earthquake resistance must be taking into account.

(c)Other Limit State – Fatigue, Durability, Fire Resistance Etc.

A structure will become unfit for use if parts or all of it collapses, but will also become unfit if it deflects too much, if large cracks forms or if the vibration is so great that discomforts and fear is caused to the occupants, or the operation of machinery is interfered with. This state is technically referred as failure; when structure ceases to be fit for human habitation and occurs when the limit state is reached. This state is reached when deflection exceeds L 250, where L is the span of the element and cracks width exceeds 0.3mm, Obiechina (2005).The structural design should therefore, ensure that the structure will not, during its life span, become unfit for use i.e. reaches a limit state. Each limit sate must, therefore, be considered in design and suitable margin of safety used; Mosley etal (1985), Obiechina (2005), Sinha (2002)
Most buildings are composed of foundations, columns, beams, slabs, roof, load bearing partition walls and complex mixture of constructional units and materials. All these put together provide and almost impossible indeterminate structures. Cracking in buildings are indicators of onset of failure. These failures or defects will now be examined in the various structural elements.

1 Foundations

Whatever the type of structure, the qualities of the subsoil must be investigated and the design and construction made to absorb stresses from the super-structure. Causes of foundation failure include: faulty or no soil investigation, wrong choice and or design of suitable foundation; use of structure for purpose other than or total settlement of substructure accompanied by excessive cracking of ground floor slab, sinking of column footings, that is, punching shear failure as shown in figure 1.

2 Columns

Columns are usually struts and therefore very strong element of the structure. They hardly fail. Causes of column failure are attributed to: most due to the use of structure for purpose other than originally intended for instance office blocks being used for storage e.g. books, machinery and heavy point loads for instance bank safes, etc., use of small or highly spaced column stirrups as shown in figure 2; Excessive slender columns leading to buckling; use of poor quality materials. The danger signals are column crushing and spalling and splitting of concrete.

3 Beams

Beams are most susceptible to all kinds of stress than other structural elements. Such stresses include that due to bending, shear and torsion. Other failure includes deflection, bond and anchorage. Causes of collapse may be due to faulty design, use of structure for purposes other than designed, poor construction methods leading to displacement of stirrups during vibration as shown in figure 3. The symptoms depend on the type of failure as shown in figure 4, viz bending, shear, torsion, deflection.
Bending: vertical cracks mostly near middle of beam length.
Shear: inclined cracks (45^0) mostly at the ends of the beam. Shear failure very sudden.Torsion: combination of horizontal and inclined cracks.

4 Slabs

Causes of failure in slab are as result of: Excessive loading especially with partition walls; Reinforcement placed in the wrong position especially due to inadequate chaining up; omission of top reinforcement at beam positions and slab ends see figure 5'; excessive spans, that is span or effective depth ratio; lack of adequate cover to reinforcements., and poor quality of materials and inadequate mixes. The common symptoms include; slab vibrates when in use; crackings especially at positions where top reinforcements are needed; rusting of bottom reinforcements and concrete spalling.

5 Cantilevers

Cantilevers are structural elements that fail most in buildings and in fact should be avoided if it is possible. However, Architects seem to like them and so the structural engineers are stuck with designing them. The causes of cantilever failure can be attributed to: Displacement or displacement of the top reinforcements during construction – see figure 6.; Insufficient bond or anchorage lengths especially in discontinuous and slabs see figure 7.; In roof gutters, column reinforcement not anchored into the roof beam as shown in figure 8.; excessive length or effective

depth ratios. Cantilever failures often occur suddenly and without warning as all three stresses – bending, shear and torsion occur simultaneously and at the same point as shown in figure 9. However, most often cracks form at positions of maximum stress, visible defection coupled with cracking of the walls above the cantilever.

III. CAUSES OF BUILDING FAILURES OR COLLAPSE

Collapse according to the Dictionary of Architecture and Construction refers to mechanical failure. Collapse is a state of complete failure, when the structure has literally given way and most members have caved-in, crumbled or buckled; the building can no longer stand as originally built. It can be seen therefore, that collapse is very extreme state of failure.
The causes of building collapse can be categorized as:Thatcaused by the influence of man;That due to natural forces (force majeur).For the purpose of this paper attention is given to that caused by the influence of man either due to his negligence or incompetence.In a communiqué issued at the end of a two-day seminar on structural failure and building collapse in August 1996; professionals in the building industry summarized the major causes of building collapse to include the following: The attitude of the public, professional bodies and governments.The absence of soil test before constructionStructural designs and details are sometimes defectiveLack of proper planningAbsence of co-ordination between professional bodies and town planning authoritiesLack of adherence to specifications by contractors.Use of unqualified and unskilled personnelPoor or bad construction practicesUse of substandard building materials Inadequate enforcement of existing laws.
However, for the purpose of this paper, attention would be focused on the under listed:

(i) Deficient Structural Drawing

Building collapse when structural drawings are based on false assumptions of soil strength, they can also collapse as a result of faulty structural details. Oyewande (1992) identified design defaults s accounting for 50 percent of collapse of engineering facilities in Nigeria.

(ii) Absence Of Proper Supervision

Even where a structural design is not deficient, absence of proper supervision on the site by qualified personnel can led to building failure.

(iii) Alteration Of Approved Drawings

During construction, many contractors either on the directive of the client or in a bid to cut corners and maximize profit, alter approved building plans without corresponding amendment to structural drawings to the detriment of the structure.

(iv) Building Without Approved Building Drawings

Building without approved drawings and in some cases no drawings at all, can result in the collapse of the building more so when the drawings were not vetted by qualified professionals or relevant authorities before the buildings are erected. Without drawings, all constructions are based on guess work.

(v) Approval of Technically Deficient Drawings

Town Planning Authorities at times approved technically deficient drawings. This may be as a result of ignorance on the part of Town Planning Personnel who vet and approved these drawings or as a result of outright corruption on their part. Money may at times changed hands resulting in the approval of such drawings.

(vi) Illegal Alteration To Existing Buildings

Client at time, on their own, alter existing structures (buildings) beyond and above the original design without any drawings, and relevant Town Planning approval. In some instances existing bungalows have been converted to either a storey building or two to three-storey structures without any drawings and supervision by qualified personnel. The result can be anybody's guess.

(vii) Absence Of Town Planning Inspection Or Monitoring Of Sites

In some cases, Town Planning Authority staff seldom visit sties to inspect or monitor progress of approved work on sites, the result of which is documented in their forms. Unfortunately in many cases, this inspection is non-existent. What this means is that buildings are put up without the Authority knowing anything about details of the construction. Unfortunately, these details are only known when such buildings collapse and their element get exposed for all to see. By that time lives probably may have been lost.

(viii) Clients Penchant To Cut Corners

A study of collapsed buildings shows that most of them are residential buildings and owned by individuals. What this meant is that one person takes all the decisions concerning the construction; due process is not followed. Nigerian client (mostly individuals) have a penchant for cutting corners by not employing qualified personnel to produce the contract documents and supervise the building while under construction, as they want to spend minimum (not optimum) amount of money on the construction (Madu, 2005). Even where qualified professionals are employed for design and supervision, most clients insist on having the final say on what goes on in the site to detriment of proper execution of the contract. Unfortunately, if there is any mishap on site, the client blames the consultants and the contractor. It is therefore obvious that client's penchant to cut corners is one of the problems in the building production process.

(ix) Use Of Substandard Materials

Substandard material especially reinforcement rods, steel sections and cement can contribute immensely to failure of buildings. Other substandard materials can also contribute to failure of buildings. Hall (1984) posited that use of low quality materials is one of the major causes of structural

failure. Aniekwu and Orie (2006), in their study, also identified low quality materials as the most important cause of failure of engineering facilities in Nigeria.

(x) Inefficient Workmanship (Labour)

Inefficient and fraudulent labour input can also contribute to failure of buildings. When a contractor cannot read drawings or where he refuses to listen to the instruction of the consultants anything can happen. Oyewande (1992) posited that faults on construction sites accounts for (40%) of collapse of structures.

(xii) Use Of Acidic And Salty Water

Use of acidic and salty water, as sourced from oceans and seas in cities like Lagos and Port Harcourt can affect the strength of concrete when used to effect the mix of cement, and sand and rods.

(xiii) The Activities Of Quacks

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. The industry has had more than its fair share of the activities of quacks that have nothing at stake whenever problems arise. The unsuspecting public is also at a loss differentiating the real professionals form the quacks until the real harm has been done.Today, it is not strange to find staff of Town Planning offices who are mainly Town Planners and Site Inspectors, even some Land Surveyors and Builders taken architectural commissions, and masquerading as architects and deceiving the unsuspecting public. Masons have overnight transformed to engineers and builders. This is a major problem of the building industry.

(xiv) Clients' Over Reliance On Contractors For Decision Making On Site

Most clients rely more on contractors than consultants on site. This is because most contractors are either their friends, relations of the clients, or are recommended by friends or relations. The result of this relationship is that client rely more on the contractors for decision making than on the consultants.What the clients fails to realize however, is that profit is the prime motive of most contractors and not because the contractor is saving them some cost. They end up reducing the thickness of floor slabs and foundation and even foundation depth; sizes of reinforcement rods, head room (height) of structures, all in attempt to maximize profits to the detriment of the construction, and because most clients cannot read drawings, they are 'taken for a ride' by most contractors. It is only when buildings fall that these fact come to the surface. Even for big projects owned by corporate bodies and governments etc, the contractors seem to have special relationship with agents of the client, some desperate contractors use blackmail and intimidation to scare away and discourage consultants from projects sites.

Usually, a combination of factors are implicated in the collapse of building as listed above; but the timing of the recent happenings in Lagos and Port-Harcourt indicates that the nature of soil is very central and the main culprit in the collapse, as these are happening especially now in the rainy season. More attention should therefore be given to geotechnical investigation for high rise structures in areas with soil that are very suspect and the water table high. Onitsha town is an instance of where such high rise buildings are the norm, but so far no building collapse has been reported. The reason is that the soil bearing capacity is very high in most areas of the town.

IV. CONSEQUENCES OF BUILDING COLLAPSE

The incidents of building collapse witnessed in the country in the recent years has resulted in the loss of many lives and the destruction of properties worth several millions of naira; as reflected in the table 1, 2 and 3 below. Many families have been traumatized and many developers have lost their life investments. From table 1, it can be inferred that between 1975 to 1995, about 26 incidents; which claimed about 226 lives were recorded in Nigeria. Table 2 reveals that between 1982 – 1996, Lagos State alone recorded about 14 incidents and about 64 dead. While in a period of two years (2004 – 2006) as reflected in table 3 about 10 incidents were reported which claimed the lives of about 243 people. In all the cases, many people were injured and some permanently disabled.

A List Of Available Records Of Collapsed Buildings
Withing The Last Two Decades In Nigeria

DATES OF INCIDENT	STATES	TYPES OF BUILDINGS	NO OF LIVES LOST/INJURED	REMOTE CAUSES
Dec, 1976	Ondo	1 Storey	8 Died	Sub-standard building material/structure
May, 1977	Oyo	2 Storey	10 Died	
June, 1977	Kaduna	School building	16 died (several injured)	Poor workmanship by contractors
Oct, 1977	Borno	4 Storey	10 died	Poor performance by contractor
March, 1978	Rivers	4 Storey	16 died	Lack of concrete services to hold foundation
June, 1982	Ondo	2 Storey	7 died	Heavy down pour/structural defects
Sept, 1983	Lagos	2 Storey	8 died	Structural defective
Dec, 1983	Lagos	4 Blocks of flats	6 died	Heavy down
July, 1985	Lagos	3 Storey	9 died	Heavy down pour/structural defects
May, 1987	Lagos	2 Storey	4 died	Structural defect/poor
Sept, 1987	Lagos	3 Storey	8 died	Structural defect/poor building materials.
Nov, 1988	Lagos	School Building	1 died (Others injured)	Substandard building materials Defective structural design
June, 1990	Rivers	School Building	50 died (several injured)	Sub-standard building materials
July, 1991	Kano	1 Storey	3 died	Heavy down pour/structural defects
July, 1991	Sokoto	1 Storey	4 died	Poor workmanship/ structural defect
August, 1991	Lagos	2 Storey	10 died	Structural defects
March, 1992	Lagos	3 Storey	10 died	Defective structural design
June, 1992	Lagos	Hotel building	2 died (several injured)	Dilapidated structures
Oct, 1993	Kano	1 Storey	5 died	Structural defects
March, 1994	Oyo	2 Storey	4 died (11 injured)	Sub-standard building materials. Structural defects/poor workmanship
June, 1994	Lagos	3 Storey	17 injured	Structural defects/ sub-standard materials
Aug, 1994	Kwara	1 Storey	2 died (6 injured)	Structural defects/poor building materials
Aug, 1994	Oyo	2 Storey	10 died (74 injured)	Structural defects
June, 1994	Lagos	4 Storey	4 died (several injured)	Structural defect/sub- standard materials
Aug, 1994	Ondo	1 Storey	1 died (several injured)	
Jan, 1995	Lagos	6 Storey	1 died	

Source: Boye Ajai – 1995 Factors Responsible for Collapsed Building P.19. Tell Magazine No.3.January 16th 1995 Culled from S.O. Izomoh (1997) the Provision of Housing and Management in Nigeria P.20.

Table 2:
Available Statistics Of Collapsed Building In Lagos Since 1982-1996

S/N	MONTH	YEAR	TY PES OF BUILDING	LIVES SAVED	LIVES LOST	POSSIBLE CAUSES
1	March	1982	Three Storey	No record	10	Weak foundation
2	June	1982	Two Storey	"	7	"
3	Sept	1983	Two Storey	"	8	"
4	May	1985	-	"	9	Faulty Foundation & bad workmanship
5	June	1985	Two Storey	"	5	Weak Foundation
6	July	1985	Three Storey	"	9	"
7	Nov	1986	-	"	1	Faulty Foundation & bad workmanship
8	May	1987	Two Storey	Many people escaped	4	Faulty Foundation & bad workmanship
9	Sept		-	Many people escaped before arrival of fire service	7	Structural Defect
10	Nov	1988	School Building	-	-	
11	Feb	1989	-	It is believed that many people escaped	-	Faulty Foundation & bad workmanship
12	May		Uncompleted Hospital Building	-	-	-
13	June	1994	Uncompleted 4 Storey Building	It is believed that many people escaped	1	Removal of form work before curing of concrete decking
14	May	1996	Uncompleted Church Building	Many people escaped	3	Bad workmanship

Source: Federal Fire Service, Lagos and Lagos State Fire Service – Ikeja

Table 3
Recent Building Collapses 2004-2006

DATE OF INCIDENT	STATES	TYPES OF BUILDINGS	NO OF LIVES LOST/INJURED	REMOTE CAUSES
Oct. 2004	Umuahia	3 Storey Building	4 dead, many injured	Unknown
May 2005	IIudun, Ogun State	4 Storey Building	10 dead, many injured	Unknown
June 2005	Aba	4 Storey Building	25 dead, many injured	Unknown
June 2005	Lagos	3 Storey	20 dead, many injured	Unknown
July 2005	Port-Harcourt	4 Storey	25 dead, many injured	Defective Foundation
July 2005	Lagos	3 Storey	30 dead, many injured	Defective Foundation
July 2005	Port-Harcourt	5 Storey Office Building	30 dead, many injured	Deviation from Approved Play / Addition of Floors
August 2005	Adamawa	Collapse of Bridge	45 dead, many injured	Defective Foundation
August 2006	Oworonshoki, Lagos	2 Storey Building	4 dead, many injured	Defective Foundation
August 2006	Lagos	4 Storey Building	50 dead, many injured	Deviation from Approved Plan.

Source: Author's Complication from National Dailies 2004-2006.

V. ROLE OF STAKEHOLDERS

It is necessary to identify the stakeholder in the process of building plan production and approval eventual execution; for better understanding of the building process. They are namely: the clients, the building professionals – architects, engineers, quantity surveyors, the approving body and then the contractor.

A. The Client

The client refers to the individual or a corporate body e.g. Banks, Institutions, Governments (Federal, State, and Local), churches, etc., that wants to develop building.It is the responsibility of the client to secure the services of qualified professionals – the architects, structural,

mechanical and electrical engineers. But most clients especially the individual clients have the erroneous impression that the service of these consultants is high and therefore prefer to patronize quacks. The results of their actions often have led to regrettable consequences in what is commonly referred to as "Penny Wise, Pound Foolish".The client must ensure that he provides building materials of good qualities and quantities as specified by the consultants for him to have a durable structure. He should respect the opinions of the professional consultants, who have their names and integrity to protect.

VI. THE BUILDING PROFESSIONALS

a) *The Architects*

Architects are persons who are trained in the art and science of building design and construction. The architect is also referred to as persons who designs buildings and supervises their erection; someone who plans something (New English Dictionary and Thesaurus, 2000). The architect according to Longman Dictionary of Contemporary English (2003) is someone whose job is to design buildings and the architect of something as the person who originally thought of an important and successful idea.It is this last definition that clearly places the architect as the number one (Prime) consultant in the building industry; just as the Civil and Electrical Engineer are the prime consultants for roads and bridges and power electrification projects respectively. He is the master builder; it has always been so, because the Greek Word 'architeckon', from which the term architect was translated from, refers to him as a chief builder.The architect co-ordinates the activities of the other members of the building team (consultants) e.g. the Engineers, Quantity Surveyors, etc. The architect initiates and finalises the design of the building by which he ensures that the form and functions of the building are in order. He also ensures that the building meets with its owners' requirement and should satisfy public safety and should not constitute any hazard to its users. He must ensure that all consultants to a contract follow due process in project design and implementation and they must be qualified to participate in the project. As the master builder and the ultimate authority on site, he must be a man of professional integrity and, should not allow himself to be 'settled' either by the contractor or supplier to detriment of the works on site. He must inspect and approve materials used on site, and ensure they are not substandard. The architect has a great stake in buildings designed by him; because he has a name to protect and would not want to be associated with any building Failure.

b) *The Engineer*

Engineering is the widest field in consulting as there are many fields of Engineering e.g. Civil or Structural Engineering, Mechanical, Electrical etc. for the purpose of buildings the above listed are the main engineering consultants involved. But in the issue of structural stability, the structural engineer is the most prominent and relevant. He must ensure that necessary tests (e.g. soil or geotechnical, cube test etc) are carried out for strength of materials on site. He must ensure that structural drawings for the project are designed to the specifics of the site, e.g. nature of soil, location of the building and type of structure, soil test must be carried out as necessary. The structural engineer is responsible for the stability or otherwise of the building. He, so to say is responsible for the skeleton of the building. The architect relies so much in his expert advice in taken decisions.The structural engineer's duty includes also supervising the structural aspect of the construction work. Besides being mentioned in the Article of Agreement, he is not given any power under the contract, hence any instruction given by him to the contractor should be passed through the architect. And this also applies to mechanical and electrical engineers if appointed Akapbio, (1978).The structural Engineer is required to submit a letter of undertaken to supervise any building more than two floors, designed by them to the Town Planning Authorities in most states before approval is issued for development. But unfortunately, most of them are ignored after the developer has gotten approval for his building plan. Most clients do not appreciate that there is a big difference between doing a paper work and physically being on site monitoring or supervising the construction process.

c) *The Building Contractor*

The building contractor is the individual or the company which undertakes to execute the building project for the client. In Nigeria, building construction contract is a big business and has become an all comers affair. Politicians, even medical practitioners, lawyers and others without any training in any of the building or built environment disciplines are now building contractors. Their only qualification in this field is political or social connections.
Unfortunately, most of these contractors do not bother to employ a trained builder who is a specialist in the field of building construction, neither an architect nor structural engineers in their firms. This is also part of the problem, because some major projects are left in the hands of those who have no competence to engage in the tasks they are undertaking. Some problems that are associated with Nigeria building contractors include: penchant to cutting corners, use of substandard materials, poor workmanship, 'big eye' for profit maximization. Because majority of the contractors are not professionals in the real sense of it; they are not bound by any professional ethics or code of conduct.
In normal situation, it is the architect in collaboration with other professionals in the building team that ought to prepare tender documents, call for tender on behalf of the client, analyzes the tender and make recommendations to the clients as to the most suitable contractor to execute the work. The consultants take some factors into consideration in recommending contractors to the client for the award of the project. These are: availability of expertise, experience, manpower, equipments, and records of past jobs successfully executed by the company, etc.Most times, however, clients especially the individual clients do not bother to follow due process in the award of their projects. They prefer awarding the projects to those they know

without necessarily considering their competence to execute the project. Engagement of competent contactor and supervisory team with relevant knowledge and due diligence will ensure that the project is executed to specification and expected quality.

d) Town Planning Authority (Tpa)

The completed drawings are now submitted to the approving body, which is the Town Planning Authority (TPA) in local or municipal government office. The department is supposed to have qualified personnel with integrity to expertly and diligently vet and approve the drawings. Most times, these departments do not have the personnel with the requisite expertise and even when they have them, most lack integrity.The Development control Units (DCU) in most states play a limited role as they lack the number of staff with expertise o supervise the many developments in progress concurrently across their areas of jurisdiction. Their main function is to ensure that the clients engage the services of qualified professional to oversee their works.

Some developers are forced into illegal developments because of the bottleneck created by the approving bodies. Many obstacles are put in the way of intending developer as it can take a developer over one year to obtain approval for complete working drawings submitted. Issues usually mentioned are proper survey, good title, consent, certificate of occupancy; tax clearance certificates, development levies, processing fees etc. are cumbersome, financially tasking and unwieldy.Recently developments in the building industry have given rise to the development of high-rise buildings. This is to maximize the value and utilisation of land, which has become very scarce and expensive. Most developers do not appreciate the dangers associated with such high-rise buildings and therefore engage services of those who do not have the expertise on such projects. Another new development that has contributed to the malaise is the addition of new floors to existing buildings because of the pressure of demand in choice locations.

VII. STRATEGIES TO OVERCOME BUILDING COLLAPSE

It is obvious from the discussions above that the problem of building collapse can be addressed first form the client or prime consultant relationship. The caliber of prime consultant engaged by the clients goes a long way to determine the quality of finished work. The prime consultant should ensure that the right things are done by all other professionals involved in the project. The prime consultant knows his limitations and allows all other professionals to discharge their responsibilities to the best of their abilities.

Second part has to do with the approving bodies. Such organizations shall be staffed with people with expertise and integrity. If the expertises to approve certain designs are not within the organisation they shall seek for assistance from the relevant professional body or consulting firms, albeit at a fee. A situation, where the following approval authorities constitute of only Tow Planning to the exclusion of architects and structural engineers is not healthy.As a matter of urgency government should put in place approving procedures that are not cumbersome a one-stop shop that will reduce the time required for the approval of building plans. A time frame shall be set and given wide publicity. This will re-assure intending developers that the process is not open-ended.The third is in the areas of execution and supervision of the approved drawings. The quality of the executing contractor is very critical and crucial. The integrity and competence of the contractor holds the key to a successful competition of the project. The contractor must posses the following attributes: Play by the books, posses expertise to do things the right way and notice defective designs have a name to protect.Contractors shall meet some criteria to qualify to execute certain categories of projects, of which buildings that are three floors and above fall into. There shall be on the staff of the contractor a registered building officer, civil or building engineer, who must take responsibility for the integrity of the structure.Supervision is also very important because it ensures that he contractor follows the drawings, keep to specifications and ensures that the quality of materials used are of required standard. It is concerned with total quality management. Good examples include ensuring that the reinforcements are of right sizes, strengths and concrete grade specified are used at all times, adequate curing of concrete, enough time allowed for concrete to gain strength before proceeding to the next stage of work etc.Also, in the area of supervision, government can through the TPA play a commanding role to ensure that collapse don not occur. In the case of buildings of three floors and above, the TPA shall demand that registered engineers be engaged by the developers to supervise the project like is done in Lagos State.This shall be take a step further, the engineer shall be made to visit the head office of the TPA where he shall undergo an interview and properly documented including taken his photograph, by a professional colleague of the rank of a director, before ratification of his engagement. Once engaged, the RE will sign of completion. In case he ceases to supervise, he shall inform the director in writing to forestall impersonation and forgery.The TPA through the DCU shall be proactive, more robust and decisive in the performance of their functions. They shall be empowered to stop illegal developments and those that do not conform to all laid down conditionalities, either by persuasion or force, if need be, with assistance of law enforcement agents. They shall also be empowered to demolish offending structures before they constitute danger to the society.The Federal Government through the Standard Organisation of Nigeria (SON) must ensure that the construction materials in the market meet required standard. Like the cases of steel reinforcement, high yield steel must be seen to have the strength stipulated, so also is materials like cement.A monitoring team should be set up under the leadership of the commissioner of housing comprising all the professionals in the industry to visit construction sites and carry out on the spot check of the activities of the contractors and the supervising engineers. This is with the view of having first hand information of how they operate and discharge their functions. The report of the team shall be used in advising the local planning authority on what necessary actions to take against the contractors and supervisors (consultants).Zoning methods can be used to

limit the number of floors to be developed in areas where the soil bearing capacity is very low. Even the type of foundation to be used in such areas can also be specified. There must be the resolve to ensure that the law is not violated or breached.The general public including civil society organizations must report any development (new building and restructuring of old ones) in their neighbourhood to the TPA and follow it up to ensure proper approvals were obtained before the commencement of such developments. The NGOs shall go a step further by the contractors by regularly monitoring these developments.

Penalties and sanctions shall be put in place for all parties involved in the actualization of the building project to the extent of their involvement, violations and contraventions. A developer of a collapsed building shall be made to forfeit the plot to the government and in addition face criminal charges for poor quality works and be sanctioned by his professional bodies, so also are other professionals, they shall all be sanctioned by their professional bodies and charged to court where criminal negligence is established.Developers shall be informed of these penalties and sanctions at the time they obtain the building plan approval. It shall be stated clearly in the approval letter.Regulatory professional bodies and their corresponding societies or association shall regularly run workshops or seminars for their members to update their knowledge and highlight the dangers and penalties associated with collapsed or failed buildings. They shall monitor activities of their members and penalise them when necessary.Developers and professional shall be educated on the need to enter into proper contracts before the commencement of any project. Now, most developers feel reluctant to enter into properly executed contract rather they prefer the informal approach. They need for proper contract cannot be over-emphasized as the document defines the duties and obligations of the parties concerned.Some completed buildings initially may appear suitable for human habitation, but with the passage of time, mostly in weak soils, the buildings begin to settle, materials begin to suffer fatigue and corrosion begin to reduce to strength of materials used. All these combine to affect the continued satisfactory performance of the building.Government as a matter of policy shall periodically inspect existing building which may be over five or ten years to ascertain whether the buildings are behaving in the manner expected of them. Those with excessive cracks, deflections and settlements shall be subjected to more close examinations to ascertain their continued suitability for human habilitation.The reason for this recommendation is not farfetched. Now, there are existing buildings that have in engineering terms failed, though they are still standing but have developed cracks, deflections and settlements of unacceptable proportion and are tilting. They pose great threats to lives and properties and are disasters waiting to happen.It is pertinent therefore to state that building collapse cannot completely be eliminated as some aspects of soil investigation and even structural analyses and design are not fully understood and predictable since they are both science and art.

Secondly, some factors incorporated in the design are based on probabilities and therefore some degrees of uncertainty are inherent. Thirdly, the soil that carries all the structures varies widely in all directions.Finally, the performance of most materials over time especially fatigue, elasticity, dynamic and cyclical loading etc are not fully understood and predictable. If all things are done accordingly, the chances of collapse occurring are very minimal and rather the few cases of collapses will afford the opportunity to study and understand the phenomenon better.The recent approval of a national building code for the building industry is seen by all professionals in the construction industry as a welcome development that will help sanitize the industry.

VIII. Recommendation and Conclusion

The recommendations shall be presented under subheadings that are considered as the main stakeholders in the industry. The following roles are expected in this regard.

1. *Government:*

At the Federal Government level. Standard Organisation of Nigeria should vigorously pursue all those involve in the production or importation of sub-standard goods especially building materials. It should rid the society of sub-standard construction materials.Ministry of Housing and Urban Development should, when expedient, use the zoning approach to limit the number of floors to be developed in areas where the soil is very suspect. It shall even go further to stipulate the type of foundation to be used.State Government through the appropriate ministry, should as a matter of urgency streamline the process of granting building plan approvals. It should provide a one-stop with a view to reducing the time required for such approvals.A monitoring team should be set up under the commissioner or Works and Housing to make regular visits to different construction sites with the view of assessing how well the contractors and supervisors (consultant engineers) play their roles.Penalties and sanctions should be developed and enacted by the state governments and houses of assemblies. The consequences of developing a failed structure shall be well publicized.State ministries in charge of building plan approvals should also ensure that the engineers supervising developments take responsibility for the structural integrity and are properly documented including taken main photographs. The engineer should be interviewed by a professional colleague in the relevant ministry of the rank of a director or it equivalent. This will forestall any impersonation, forgery and denials in the future. Governments should put in place a policy for checking existing building periodically, may be every 5 or ten years, to ascertain their continued suitabity for human habilitation. Hence, the local planning authority shall concern itself with only approval buildings of two floors and only oversee higher buildings in collaboration with the zonal town planning office or the head office.

2. *Developers:*

Clients or developers will need to be circumspect fin the choice of prime consultant to ensure they engage competent prime consultants with integrity.

Clients or developers should rely on professional advice to engage contractors to execute their projects. This will not only ensure that the right contractor gets the job, but that it gets it done correctly and on time.Developers should also endeavour to sign proper contracts with both prime consultant and the contractor, defining responsibilities and obligations. Acrimonies in the scope of works that are associated with informal contracts will in this way become a thing of the past.

3. Professionals:

Professionals must be men of knowledge and integrity. In cases of jobs they are not trained for or lack competence to execute, they must always secure the best services for their clients if requested to, otherwise they should not undertake such works.Pecuniary benefits should not be the driving force in their relationship with their clients, but they should be motivated towards providing the best professional service at reasonable price and in a timely manner. Besides, they should always strive to enter into formal contracts with their clients as this will define the scope of services/works expected of them (responsibilities), the time frame and the consideration.

4. Regulatory Bodies:

Professional bodies like the regulatory organs and their corresponding societies or associations will be expected to conduct mandatory regular workshops or seminars for their members to keep them abreast of current developments in their chosen profession.Members will be expected to attain some basic points by attending such seminars and failure to meet up with the stipulated minimum, should result in striking off their names from the register of registered members.These bodies should set-up units to monitor the activities of their members, make random visits to project sites where those found wanting in the discharge of their duties should be sanctioned.

5. Civil Society And Non-Governmental Organisation:

Civil society, especially the NGOs' are to act as watch-dogs to report any new developments and even the restructuring of old buildings to the relevant authorities.Specialized NGOs in matters relating to safety of the environment shall be encouraged. They will be expected to monitor these developments and report their findings to the relevant authorities.If these recommendations are religiously implemented, it is expected that the menace of building collapse will become a thin of the past and only occur in situation of *force majore.*

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