



INCESSANT BUILDING COLLAPSE IN NIGERIA: ASSOCIATED MATTERS AND SOLUTIONS

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ABSTRACT

The alarm bells keep ringing on the matter of building collapse in Nigeria. On February 02, 2023 a two storey building under construction collapsed at Gwarimpa, Abuja. On April 12, 2023, a seven storey building under construction at Banana Island collapsed killing one person. On April 22, 2023 a block of flats collapsed in the Sango Police barracks at Ibadan, Oyo State with many trapped. A one storey hotel annex building collapsed at Udu, Warri on Thursday April 27, 2023.

It is therefore clear that safety is not guaranteed inside many buildings in Nigeria. The root cause of this persistent collapses is deeply investigated with solutions proffered in this paper.

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1.0 Preambles: The Housing Sub-Sector

Considerable potential exist in the housing sub – sector in terms of creating jobs, driving economic growth and contributing to diversification. According to Okonjo – Iweala (2012), “Nigeria has a housing deficit of 12 – 16 million units. An additional 720,000 units are needed per year.” With the country in the ranks of those with the fastest urbanization rates in sub – Saharan Africa, this deficit is obviously a strong economic growth driver.

Buckley, Frank and Olajide (1993) posited that the main instrument through which the severe shortages and cost of shelter in Nigeria would be tackled is the private sector, in consonance with the principle of increased private sector participation. Rather than play the role of direct implementor of the National Housing Policy (NHP) of February,

1991, government is to act as promoter, enabler and facilitator to individual and co – operative housing efforts; Anyanwu, Oyefusi, Oaikhenan and Dimowo (1997). This is very cheery news to the Nigerian Structural engineer and other professionals in the building construction industry.

This amount of deficit in the housing sub – sector certainly calls for care in on – going and future construction works so as to avoid failures and collapses that widens the existing deficit.

1.1 INTRODUCTION

The English dictionary defines collapse as: to fall down suddenly, to cave in; to cease to function due to a sudden breakdown.

Concerted efforts have since independence, been made by the Nigerian government through huge budgetary allocation and policy provisions in the area of quantitative but certainly not qualitative supply of mass housing. Very alarming and surprising though, the rates of collapses require urgent attention. Can you imagine what edifices, the totality of collapsed buildings in Nigeria would have been if they were properly constructed? Can you also imagine the housing deficit gaps that these collapsed buildings would have remedied in totality? Can you imagine the total amount gone down the drain via these collapses? Can you imagine what that amount would have done to our economy if it was usefully invested elsewhere? Can you imagine the material / property losses incurred via these collapses? Worst of all, can you imagine the colossal human lives and destinies that were terminated abruptly in these collapses?

Famoroti (2005) averred that Nigeria, Lagos State in particular, has become the ‘world’s junkyard’ of collapsed buildings worth billions of naira.

Fadamiro (2002) posited that a building is “an enclosure for spaces designed for specific use, meant to control local climate, distribute services and evacuate waste.” Odunlami (2002) defined buildings as “structures for human activities, which must be safe for the occupants.” Therefore, a building is a structural entity with structural members such as roof (sheeting and carcass), beams, columns, staircases, floor slabs, lifts and foundations, depending on size and type and covered / partitioned with a view to meeting desired functions and services.

Building collapse which connotes an extreme case of building failure occurs when the superstructure crashes down totally or partially, Arilesere (2002). Rather than provide conveniences and shelter to people, vast number of buildings have become some form of danger waiting to happen. Olusola, Atta and Ayangade (2002) posited that functionality (performance), elegance, durability, fire resistance, buildability, cost effectiveness, safety, quality, and

timely completion are basic requirements expected of buildings. It is even more amazing in our clime that majority of these collapses are obviously not because boundaries are pushed due to complexity but by reasons bordering on quackery and compromises.

1.2 Project types and failure / collapses

It is essential to mention that failures and collapses could be associated with project types namely:

1. Traditional – these are projects with clear goals and solutions. Most building projects in Nigeria are repeated with already known solutions in design and execution. Complexities are low but even when they are, they are still well defined, Wysocki (2009). Risks in traditional projects are generally very low.
2. Agile – these are projects with clear goals but the solution is not. They are high risk projects. Projects with high level of provisional sums fall into this category. Failure and collapses could be more.
3. Extreme – these are projects whose goals and solutions cannot be clearly defined. They are mostly research and development oriented projects. Risk levels are higher than the agile case.
4. Emertxe – these are projects with solutions but no goals. These are new technology projects without application e.g. the radio frequency identification technology (RFID), when it first came out. Some R & D projects are also in this category. Complexity is quite high and risk is way too high.

1.3 Boundaries of paper presentation

The projects under discussion are of the traditional and agile categories. The agile is highly risky but observations have shown that more of the collapses have occurred on private residential buildings whose risks of design and execution are very low.

1.4 Reasons for collapse of buildings

Bolaji (2002) posit that buildings mainly fail through ignorance, negligence and greed. When incompetent personnel are charged with design, construction, supervision and project management, ignorance holds sway. Copying and pasting of specifications written for other projects without improving on them to suit the project at hand is stark negligence. The use of substandard materials and diversion of materials to another place rather than the requisite site are all products of greed with the contractor as major culprit.

Besides our approval process, monitoring and structural appraisal / assessment, also examined in this paper, some other reasons (includes poor selection processes are) are:

1. Design deficiencies – calculation errors, assumed loading errors, deformation, bearing support problems, secondary stresses, elastic cracking, temperature and shrinkage problems, detailing and draughting, changes and alterations without due diligence to load transfers and supports etc could wreck havoc on buildings. 1. Inadequate design briefs – when clients fail to give all necessary information about functionality of building, the

building becomes defective even from inception. Cases of buildings designed as residential but in the service life changed to offices, schools, worship centres, with higher imposed loads are rife in our society. Cases of concealment of actual use of structure to evade regulatory authority charges are other cases of note.

2. Quackery – it is not uncommon to see investors who are willing to spend huge financial outlays on materials and lands procurement but pay deaf ears to engaging a structural engineer who is charged with ensuring the stability of the structure. Many architects, quantity surveyors, structural engineers, services engineers and other built environment professionals frequently outdo one another by patronizing draughtsmen, artisans and freshers in the various professions even when they know better.

Foundation issues – instead of doing due diligence on soil tests / subsoil investigations and analysis, even professionals over reach themselves by making

assumptions that may not necessarily be the true position. It is a fact that specific foundations suit specific soil conditions and bearing capacities. Unequal settlements arising from changing sub-grade condition or by incorrect design assumptions, inadequate / unequal support for foundations, soil and ground water

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professionals over reach themselves by making assumptions that may not necessarily be the true position. It is a fact that specific foundations suit specific soil conditions and bearing capacities. Unequal settlements arising from changing sub-grade condition or by incorrect design assumptions, inadequate / unequal support for foundations, soil and ground water movements as well as expanding soils, according to Fadamiro (2002), leads to crushing and collapse of concrete footing or other foundation members.

2. Weather and climate change – these have wrecked havoc on many structures particularly houses, roads and bridges. Chukwunke (2015) averred that when “rainfall that is supposed to sprad in an area over a month comes down under few hours, the runoff swells rivers, and drains are overwhelmed and, the resulting flow reduces to nothing everything on it’s path.” Lower case buildings are simply washed away while some upper cases collapse with piles still attached to their foundations while bridges, roadways, etc are also not spared. 1.

Wrong tender / selection processes – the best price for any project may not necessarily be the lowest tender. As

a matter of fact, cases of contractors and tenderers deliberately lowering their costs just to win bids are numerous. The consequence of this untardy act is that compromises and cutting of corners are rife, thereby putting the safety of the structure in jeopardy. It is not uncommon for officers of some organisations to also unduly favour some tenderers with the aim of being ‘settled’ when the job commences. This act pushes the contractor to do

Shoddy jobs after such settlements. Some high profile officials of government and private sectors are not spared of this act.

2. Quality management – materials utilization in the building industry needs stringent quality control measures. Neglect of general material tests and concrete mix designs / tests could lead collapses. Cases of adopting 11mm or 11.5mm for 12mm diameter rods, 9mm or 9.5mm for 10mm, 14mm or 14.5mm for 16mm, 18mm or 18.5mm for 20mm rods are still in the industry, though not as rampant as before now. The difference between imported reinforcing bars and the local counterparts is clear while some manufacturers mix cast iron which is brittle with the real rods. Structural engineers must insist on appropriate test results.

1. Unprofessional conduct – taking bribes from contractors and professionals acting beyond the scope of their areas of expertise affects quality and lowers desired standards. No doubt that this is an avenue for collapse.
2. Inadequate maintenance – the maintenance culture in this country is very poor. Once a building is completed and handed over, even the defects liability period is scarcely observed and implemented. Hasty use without regular maintenance would only lead to accumulated and increased damages that could ultimately lead to collapse. We are well known for fire brigade approaches to issues and we are rarely serious until disaster occurs. The culture of providing maintenance sums as part of contract is not yet part of our construction processes

2.0 APPROVAL PROCESS

According to Real World law (2019), “the process of obtaining permission for development commences by an application for planning information to confirm the land use / zoning, building development control and land status. The

Application for planning information to the relevant authority is usually accompanied by copies of the land survey plan and relevant title documents.” The application for building development is made to the Physical planning Permit

Authority

Here are the requirements for obtaining building approval

1. Proof of Land ownership such as Purchase Receipt with Stamp Duty, duly – executed Deeds along with other Statutory Documents
2. Survey Plan
3. 5 sets of Architectural Drawings
4. 5 sets of Structural Drawings
5. 5 sets of Mechanical Drawings (Commercial building)
6. 5 sets of Electrical Drawings (Commercial building)
7. Tax clearance
8. Planning Technical Report (where necessary)
9. Where necessary clearance from:
 - i. Land Use and Allocation Committee
 - ii. New Town Development Authority (NTDA)
 - iii. Ministry of Environment (Drainage Department)
 - iv. Ministry of Transportation (Metro Alignment / Traffic Report)

1. Photocopy of Payment of Assessment fee
- Right of ways and Setback for Proper Building Planning

Setbacks are necessary to avoid building illegal structures ie structures that don’t conform with urban planning rules. According to Physical Planning Website, a setback is the distance to be observed between the building line and property boundary, water bodies, right of ways of infrastructure facilities and utilities.

Below are the setbacks for the different right of ways

- i. Federal Highway – 90m right of way ie 45m from the centre to the property line.
- ii. State Highway – 60m right of way ie 30m from the centre to the property line.
- iii. Local Road (State) – 24m, 18m, 15m, 12m (12m, 9m, 7.5m, 6m right of ways respectively from the centre to the property line as applicable).
- iv. Building line of property and the outer edge of NNPC oil pipeline – 15m

Required setbacks from different water bodies:

- a. Ocean/Sea – 150m
- b. Lagoon -50m
- c. River – 15m
- d. Seasonal – 15m
- e. Gorges (New and Built – up areas) – 10m

Distance to rail line:

- i. Railway line – 21m
- ii. Unmanned railway crossing – 60m

Required setbacks from different power lines:

- a. 132 KV power line –15m
- b. 330 KV power line –25m
- c. 11/33 KV power line –5.5m

It is the duty of the property owner to ensure that proper setbacks are adhered to. When measuring and marking out your landed property, surveyors should be instructed or reminded to observe correct setbacks. It may lead to one's land not being the size paid for but there is assurance that the property is out of government's right of way and safe from future demolition.

[B] Specifically for Abuja, FCT

The Department of **Development Control (DDC)** – Federal Capital Development Authority (FCDA) is the body incharge of building plan approval in Abuja, Rural Homes Limited (2018). The required documents for submission to the DDC are:

1. Offer Letter
2. Right of Occupancy
3. Certificate of Occupancy (C of O) for Transfer of Ownership
4. Registered Deed Assignment
5. Architectural Design
6. Structural Design
7. Electrical Design
8. Mechanical Design
9. Soil Test
10. Environmental Impact Assessment (EIA)
11. Other Documents Where necessary

Armed with the above documents, the following steps ought to be taken:

- a. Contacting the DDC and stating intentions of part or all the below stated: erection of new buildings, major improvement works, and total redevelopment works
- b. With an application form, both soft and hard copies in A3, firmly bound and legible prints containing general notes, technical specifications, details drawn to prescribed scale without prejudice to copy right laws.
- a. Prior to commencement of works, notice must be given indicating intended construction methodologies which must be authenticated by a government licensed / Chartered Engineer who will bear liability for the construction and or installation defects. All drawings must therefore contain original seal, stamp and signatories of relevant registered professionals as appropriate
- b. Submission of completed forms with documents 1 to 11 above
- c. For land use considered special such as petrol filling station, water supply, drilling / outlets, private health / educational facilities, child welfare related developments, etc shall be accompanied by letters / license of relevant regulatory body.
- d. Upon verification and acknowledgement, necessary bills are paid within two weeks from date of acknowledgement to enable processing of application.
- e. Regular building permits are not to exceed 90 days from date of submission before being granted unless the department gives a notification to the contrary or the developer so requests.

NOTE – Well intended though, the only worries noticed by practice are:

1. the sharp practices of irregular billing
2. not having requisite professionals to check submitted designs and details thereby shifting responsibility back to the designers and supervisors
3. irresponsible practices of built industry professionals who sit in these approval bodies just to stamp drawings they scarcely vet on the spot for some pittance.

3.0 STRUCTURAL CONDITION APPRAISAL/ASSESSMENT

While it is imperative that new structures be designed and detailed with due engineering diligence and best practices, constructed under the strictest sense of engineering supervision, already existing structures especially with no records of engineering supervision pose great societal danger if nothing is done about them. Herein lies a major opportunity for structural engineers to exploit in **construction and service life analysis, and non – destructive testing, evaluation & services**.

Carrasquillo Associates Ltd (2015) opine thus, “a structural condition assessment is the process of collecting observations and data and systematically using them to evaluate and assess the condition of an existing

structure.” While every structural condition assessment is unique, engineering judgement based on size of structure, type and quality are required to determine the steps necessary for an adequate structural condition assessment.

The Guidelines for structural condition assessment of buildings can be found in EN 1504 - standards for products and systems for the protection and repair of concrete structures. Similarly ASCE 11 can be adopted.

3.1 Structural Condition Assessment Process

This involves a basic inspection of critical members and areas followed by a detailed inspection of larger portions of the structure, as may be necessitated by the basic inspection.

1. Basic Inspection

This consists of reviewing of documents so as to establish the original design information and criteria, followed by a visual condition assessment. Though visual observations are determined by the structure being evaluated, the survey involves close inspection of the structure or portions of given structure to document findings. Included in visual inspections are:

- Construction details and type of construction
- Settlement, heaving, bowing, warping, sagging, and any other distortion
- Moisture accumulation
- Concrete cracking, scaling, spalling, or delamination’s
- Discoloration / staining
- Corrosion of metal objects

1. Detailed Inspection

Based on the results of the visual structural condition assessment, a detailed inspection plan is developed. This includes:

- A more stringent and thorough document review while awaiting more documents
- Development of a detailed testing and analysis protocol. This includes determining the most appropriate destructive and non – destructive test methods for further investigation of observed conditions and distress.

The non – destructive testing (NDT), are valuable resource in assessing the structural condition of the building. Furthermore, they help to further investigate the nature and causes of observed distress. [

NDT services include:

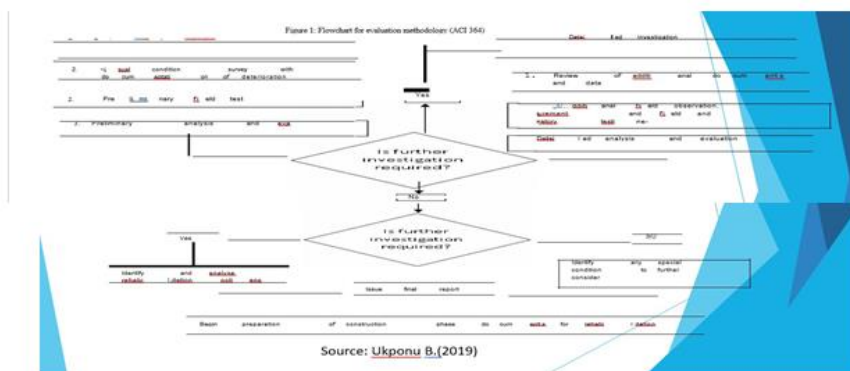
- Location of positions of concrete steel reinforcements for additions or penetrations to existing structure.
 - Evaluating the level of deterioration and quality of an existing building.
 - Identification and confirmation of the particular structural distress noticed.
- Determining the locations of samples to be taken, and determining the quantities of needed samples.

3. Summarizing Report

This report includes:

- The scope of the structural condition assessment
- The results of the basic inspection
- The results of the detailed inspection
- The summary of the testing methods and techniques adopted
- Recommendations for best course for further analysis, repairs, remediations, and / or retrofits as required.

The flow chart below could be employed in structural condition appraisal / assessment.



1. Monitoring of projects

Be it ongoing or existing projects, the need for monitoring cannot be overstated. Proper staffing of projects is key.

The essence of monitoring is to ensure that contractors comply with specifications in the case of ongoing projects while for the existing projects, it ensures that structural condition appraisals / assessments are done when necessary.

The approval / regulatory authorities, engineering professional bodies (COREN / NSE) and the project team (especially the architects, structural engineers, services engineers and the contractors site engineers) have designated roles to play in monitoring the project to ensure that quality is not compromised at every stage of the project.

The site engineers first ensure that the project drawings and recommendations are strictly followed. The consultants would then cross check to ascertain that the works are properly and qualitatively executed. The structural engineer must certify the work and as practiced at Abuja, FCT, the regulatory authority, certifies every stage of casting to ensure that reinforcements and other requirements are properly and adequately placed.

So long as no party is taking undue advantage of the other, the above is a perfect arrangement. The aspect of site inspectors spearheaded by COREN is yet to be properly implemented. Backed up with necessary laws and accompanied by law enforcement agents, better results in monitoring could be achieved by COREN. In the case of already existing structures, regular monitoring with condition appraisals /assessments ought to be regularly conducted to determine appropriate measures that could forestall collapses.

4.1 Managing Projects Effectively to avoid collapse and failure

The interplay between the prime stakeholders - the client, project manager, consultants and contractor on any project border on the five process groups, namely:

1. Scoping (Initiating)
2. Planning
3. Launching (Executing)
4. Monitoring and Controlling
5. Closing

Nine knowledge areas are necessary for effective management of projects

- i. Integration
- ii. Scope
- iii. Time
- iv. Cost
- v. Quality
- vi. Human Resources
- vii. Communications
- viii. Risk
- ix. Procurement

Chukwuneke (2015) averred that “there is collapse of structures in spite of excellence in producing the documents used to implement the project.” Thus collapses occur not because implementation documents are faulty. Furthermore, he posited that “if we see the successful implementation and use of the project, as the sum, aggregation of knowledge steps, implemented as instructed or intended, then these steps form a continuous band, which when completed leads to a successful project. When any of the aggregate knowledge step is not implemented or poorly implemented, then the project may collapse or is a candidate for collapse waiting to happen when those aggregated knowledge steps have reached their expiry point and sustenance level.”

4.2 The Scope Triangle

The scope triangle gives insights into the changes that could occur in the life of a project. Soon as work starts, something(s) would surely change:

- a. The client could call for additional features not taken cognizance of in the planning stages.
- b. Market opportunities could change to necessitate a rescheduling of deliverables to an earlier date.
- c. A key member of the project team could leave and it is difficult to replace him / her.

According to Wysocki (2009), the above stated and even more could throw the system out of balance and even escalate to failure and collapses if the personnel are incompetent. However, for the competent team the following roles are maintained:

1. The project manager controls work schedules and resource utilization
2. Management controls cost and resource level
3. The consultants control quality
4. The client controls scope and delivery dates

When solutions to accommodate changes are sought, the project manager adopts the hierarchy of scope, quality and delivery dates.



It is therefore obvious that poor implementation of aggregate knowledge on a project could lead to collapse. The responsibilities of the client, project manager, consultants and contractor must be carried out resolve any grey areas that could deter accurate mental picture of intended deliverables.

1. Conclusion

The threat and danger posed by recurring and incessant collapse of buildings in Nigeria is a very serious emergency that require concerted efforts of all stakeholders to tackle it. Added to the existing deficit of 12 – 16 million (720, 000 units per year), it is a formidable challenge to the entire nation. The other side of the coin is that it is an opportunity to professionals in the built environment, including the structural engineer.

We must rise up as a body to play our part and reap from the abundant opportunity so presented. Government on the other hand must have the will to promote and provide the enabling environment required by industry experts to tackle and terminate this danger.

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